COLONY OF THE GAMBIA.

IMPERIAL BUREAU
29 OCT 1928
OF MYCOLOGY

THE ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE

FOR THE YEAR 1927–8.

Price 5/-

PUBLISHED BY THE CROWN AGENTS FOR THE COLONIES,
4, MILLBANK, LONDON, S.W 1.

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DEPARTMENT OF AGRICULTURE, THE GAMBIA.

REPORT

OF THE

DIRECTOR OF AGRICULTURE

FOR THE YEAR ENDED MARCH 31st, 1928.

CLIMATIC CONDITIONS.

During the year under review, the climatic conditions were abnormal, the rainfall being much above the average and only a few inches below that for 1923, which was the highest recorded for twenty-nine years. At Cape St. Mary 77.03 inches were registered and 78.08 inches were recorded at the Sukuta Farm.

GROUNDNUTS.

The early part of the growing season proved very favourable to groundnut cultivation. The rains commenced earlier than usual and continued throughout the growing period without intermittent periods of drought as in the previous year. The crop, however, suffered severely during the ripening and reaping period from the excessive rains which were then experienced.

THE AVERAGE MONTHLY RAINFALL THROUGHOUT THE PROTECTORATE* FOR 1926 AND 1927 WAS AS FOLLOWS :—

	1926.	*1927.*	*Increase.*
May	Nil	2.57	2.57
June	4.54	4.98	.44
July	7.74	5.73	—
August...	11.21	16.37	5.16
September	6.73	11.59	4.86
October	1.94	7.35	5.41
November	Nil	1.16	1.16

From these figures it is seen that from 1st September to 30th November 8.67 inches of rain fell in 1926 and 20.10 inches were recorded for the same period in 1927. Much of this rain fell after reaping operations had commenced and special efforts were made by the officers of this Department working in co-operation with the Travelling Commissioners and Chiefs to get the farmers to open up their groundnut heaps to prevent heating and fermentation. Where this advice was followed little damage resulted, but where it was disregarded fermentation was rapid and much damage was done to the nuts and to the quality of the oil. The extent of this damage cannot be accurately recorded until 1929 when all the analyses have been received from the oil mills.

* Excluding Bathurst as no crops are grown there.

The quality of the Gambia groundnut crop has greatly improved during the last four years and this temporary set back is much regretted by all concerned. Extra care has been taken to select specially good seed for the forthcoming crop and in these efforts I desire to thank the Merchants trading in the Gambia for their ready co-operation in permitting this Department to select the best seed available at the various buying stations throughout the river. Past experience has shown that with specially selected seed the position can be retrieved in one season, and I desire to impress upon all concerned that given the average rainfall in the coming year we can guarantee that the Gambia crop for 1928-9 will be up to its former high standard and Buyers may therefore look to the coming season with confidence.

The quantity is expected to again show a considerable increase over that for the previous year.

Prices ranged from 2s. 10½d. to 3s. 3d. per bushel during December and January and declined to 2s. 6d. later in the season.

Improvement in Quantity and Quality of Gambia Groundnuts.

When this Department was established in 1924 the Colony had earned an unenviable reputation among the European buyers for the inferior quality of its groundnuts.

The first objective of this Department was therefore to improve the quality of the groundnut crop and so regain the confidence of the manufacturers. Records supplied by the French oil mills show that upon Commercial Chemical Analyses the Gambia crop of 1926–7 produced an oil superior in quantity and quality to that from any other source during the same period.

The following comparison is of interest in this connexion as Senegal has for many years produced the finest groundnuts. The figures given below are particularly valuable and interesting as they are the averages obtained from the actual analyses of each cargo received at the three oil mills in Marseilles and Bordeaux throughout the whole year.

Average yield and Free Fatty Acid Content of Groundnut Oil obtained from Gambia and Senegal Groundnuts at Marseilles and Bordeaux throughout 1926–27.

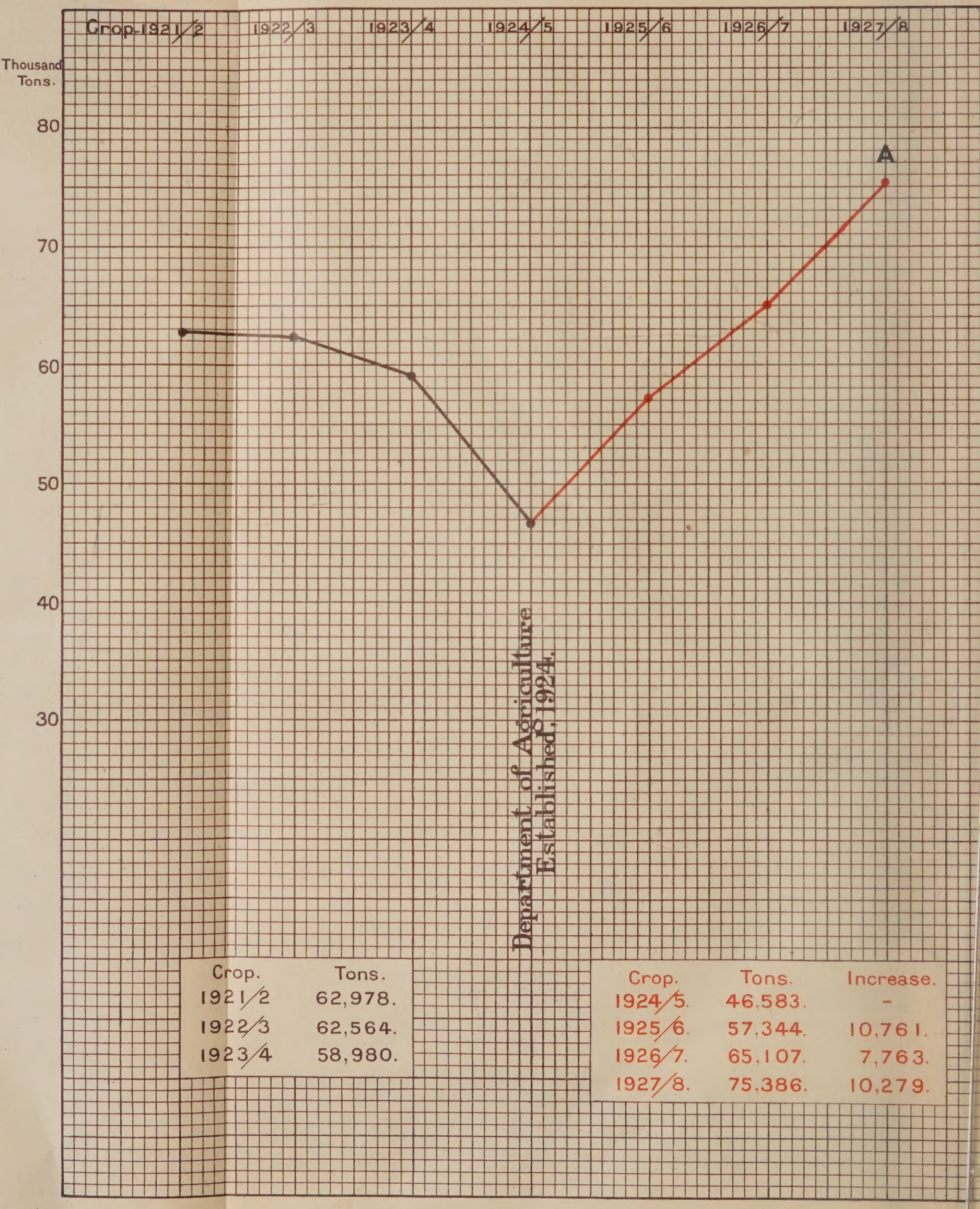
	Yield in Oil Per Cent.	*F.F.A.*
Gambia	49·60	0·7
Senegal	48·99	0·7

Further comparisons with Senegal and other countries are given in the Appendices to this report.

The marked improvement in the Gambia produce has not been obtained by any one particular effort but rather by a number of steps all of which are equally important and more or less dependent upon each other in so far as the desired result is concerned.

Special selection of the best and heaviest seed for distribution to the farmers; screening before shipment and thus enabling better circulation of air while in transit; and improved methods of reaping are among the factors which have contributed to this success. Continued effort along these lines must be maintained if the present satisfactory position is to be retained.

ANNUAL EXPORT OF GROUNDNUTS.



Crop.	Tons.
1921/2	62,978.
1922/3	62,564.
1923/4	58,980.

Crop.	Tons.	Increase.
1924/5.	46,583.	-
1925/6.	57,344.	10,761.
1926/7.	65,107.	7,763.
1927/8.	75,386.	10,279.

A. Actual quantity purchased but export not completed.

Annual Exports of Groundnuts.

The export figures for groundnuts again show an increase over the previous year. The actual increase being 7,763 tons exclusive of Saboya nuts from the French territory.

Upon reference to the following chart it will be seen that for some few years previous to the creation of this Department a steady decline had set in. This decline was in the opinion of those most competent to judge due to the increasing strangle hold of the French railway, the extension of which enabled French nuts which formerly came into the Gambia to be sold at the rail head instead of being conveyed to our wharf buying stations along the river. The Agricultural Department was established in 1924 and its immediate effect was to accelerate considerably the decline which had set in. This was unfortunate from a revenue point of view—the export tax on groundnuts being 20s. per ton—but this Department first aimed at improving the *quality* of the crop which at that time contained an average of 8 per cent. adulteration before any attempt was made to increase the output. The Compulsory Screening Ordinance was drawn up and became effective at once with the result that adulteration is now within the 2 per cent. allowed by the Trade and the Colony has benefited both in reputation and by having the previous discount of 30s. per ton removed which was formerly imposed on Gambia groundnuts by the European market.

Notwithstanding the fact that any adverse influence which the extension of the French railway has had is still operative, and the reduction in the number of strange farmers, also the increased toll being taken annually by the ravages of rosette disease, and the reduction in tonnage by the removal of sand and foreign matter from the crop the decline has stopped and a satisfactory increase shown during the last three years which there is every reason to believe will be maintained.

Table Showing Population and Quantity of Groundnuts Purchased in each Province, 1927–8 Crop.

Province.	Area. Sq. Miles.	Population.	Groundnuts. Tons.
Upper River	703·8	34,011	22,469
North Bank	813·8	63,237	15,172
South Bank	925·0	39,768	14,954
McCarthy Island	565·9	28,860	12,200
Kombo and Fogni	990·1	34,425	10,591
Totals	3,998·6	200,301	75,386

GOVERNMENT GROUNDNUT SEED SUPPLY AND DEPOT SCHEME.

An outline of this scheme which is to guarantee sufficient selected groundnut seed of good quality being reserved each year for distribution to local and strange farmers was given in my Annual Report for 1925 and received the approval of the Secretary of State in time for it to come into operation during the year under review.

Seed Distributed, 1927–8.

The quality of selected seed distributed under this scheme during the year was 13,992 bags of four bushels and distribution was as follows :—

Province.	Bags containing Four Bushels. 1927.
Upper River... ...	5,316
South Bank	5,163
McCarthy Island ...	2,800
Kombo and Fogni ...	471
North Bank	242
Total ...	13,992

Financial Statement of the First Year's Working of the Seed Distribution Scheme, 1927–8.

Expenditure.	£ s. d.	Revenue.	£ s. d.
Purchase of 704¾ tons Seed Groundnuts	8,095 10 0	Sale of Seed to Chiefs, 55,968 bushels @ 4s. 6d. per bushel	12,592 16 0
Bags, 20,000	1,126 1 7		
Labour, freightage and porterage	132 5 0	Sale of Surplus and Damaged Seed	58 9 8
Government Interest, 5 per cent. on Advance	354 14 10	Value of Bags on hand, 5,862 @ 1s. 1½d.	329 14 9
	9,708 11 5		
Balance.—Profit transferred to 1928–9 Scheme	3,272 9 0		
	£12,981 0 5		£12,981 0 5

Selected Seed in Store for 1928–9 Distribution.

The general groundnut crop for 1927–8 showed considerable variation in quality, the weight of a cut bushel of groundnuts varying from 21 lbs. to 30 lbs. even in the same district. Considerable pains have been taken in selecting the heaviest and best nuts for the forthcoming crop. Given favourable climatic conditions the 1928–9 crop should prove superior in quality and quantity to that of the season now under review.

The following quantities of selected seed have been stored and will be distributed as follows :—

Province.	Four Bushel Bags
South Bank	7,150
Upper River... ...	5,127
McCarthy Island ...	3,000
Kombo and Fogni ...	654
North Bank... ...	400
Total ...	16,331

STRANGE FARMERS.

Conditions prevailing in the Gambia during the year appear to have proved more attractive to the Strange Farmer as there was a total increase of 3,684 in their number.

This increase was shared by all the Provinces although the South Bank Province proved the greatest attraction.

THE ACTUAL DISTRIBUTION WAS AS FOLLOWS :—

Province.	Actual Numbers.		1927.	Increase over previous year.
	1925.	1926.		
Upper River	4,977	5,389	5,498	109
McCarthy Island ...	1,671	1,068	1,665	597
South Bank	4,139	3,470	4,945	1,475
North Bank	1,731	1,253	2,229	976
Kombo and Fogni ...	2,134	2,373	2,900	527
Totals ...	14,652	13,553	17,237	3,684

The annual distribution of seed groundnuts will no doubt have a very favourable effect upon the numbers of Strange Farmers coming into the Gambia.

PRODUCE INSPECTION.

The produce inspection scheme is now working smoothly and effectively and the results achieved have more than justified its inception. At a meeting held in London on 11th November between the Director of Agriculture and the Principals of the English and French firms established in the Gambia, it was unanimously decided that the present scheme had proved entirely satisfactory and that no further amendments to the existing Ordinance were necessary. A large number of the original native inspectors had to be dismissed for incompetence or corruption, but the present staff working under close European supervision have proved efficient and satisfactory.

The effectiveness of this scheme is clearly demonstrated by the fact that the average adulteration for the whole crop of 1926–7 proved upon analyses to work out at 2.2 per cent., thus being only ·2 per cent. above that allowed.

Every effort was made to avoid prosecutions under the Screening Ordinance but after repeated warning had been given it was necessary to prosecute in one or two cases for wilfully disobeying orders to rescreen.

These prosecutions serve to show that the provisions of this Ordinance must be obeyed if we are to maintain a standard of purity in our groundnut cargoes acceptable to the buyers.

PALM KERNELS.

A slight increase is shown in the exports of palm kernels over the previous year. While the general tapping of the palms for wine continues there is not likely to be any marked progress in this industry. The quantity exported was 719 tons valued at £11,611 as compared with 676 tons valued at £11,293 for the previous year. An inspector for palm kernels was again maintained by this Department throughout the year.

HIDES AND SKINS.

The export figures clearly indicate the terrible losses which occurred during the year from cattle disease. The increase alone in the number of hides exported being almost double that of the total export for the previous year. The actual increase being 18,545 over the figures for 1926. The average number of hides exported for the previous three years was 11,930, the actual number exported for 1927 was 28,316 valued at £9,288.

CATTLE DISEASE.

A very serious outbreak of disease—believed to be contagious Bovine Pleuro-pneumonia—occurred again among the cattle in the Protectorate during the year. This outbreak commenced in May and had run its course by the end of October. Every effort was made to check the spread of this disease but in the absence of a Veterinary officer and a properly trained staff of native assistants little could be done.

I estimate the actual loss on this occasion to be between 16,000 and 18,000 head of cattle. This estimate is arrived at by taking the figures supplied to me by all the firms dealing in hides. The average total purchases of hides for the period 1st May to 31st October for the preceding five years—1922 to 1926—was 5,010. The highest in any one year for this period being 8,503 in 1924 and the lowest in 1922 when 2,681 were purchased. During the same period for 1927 while the epidemic was raging no less than 21,443 hides were purchased showing an actual net increase over the average for the previous five years of 16,433. As there is no other way to account for this considerable increase it is reasonable to assume that the minimum loss due to this outbreak was in the neighbourhood of 16,000 head of cattle.

Moreover, if we take the purchases of hides for the whole year as shown by the list of exports we find that the actual increase for the year under review over the previous year was 18,545. As a portion of these figures may fairly be taken as representing a certain normal increase in the meat trade, it is better to rather under than over estimate the loss incurred, and I therefore prefer to place the loss at a minimum of 16,000. This is a very severe loss to the agriculture of the Colony. It is highly probable that all the animals susceptible to this disease at the time succumbed to it and those remaining are more or less immune. Each year—with new births—our susceptible animals will be on the increase and in like proportion our risks of the future. Further serious outbreaks must therefore be anticipated in the near future.

Owing to our peculiar conditions and to the constant trade in cattle being carried on between our farmers and those of trench territory it is necessary that whatever action we take with a view to reducing these heavy losses should be in close co-operation with our French neighbours.

While realising that owing to our geographical position it will be impossible to entirely eradicate this disease from the Protectorate I think a great deal could be done by the use of "Culture Vaccine," and the better control of cattle, to reduce these recurring losses to a minimum.

I have already submitted my views in a separate report as to what general line of action should in my opinion be taken.

AN ALTERNATIVE CROP.

In a one-crop Colony like this the question of an alternative crop assumes great importance, particularly when the only staple crop at present grown is subject to virus diseases. The climatic conditions coupled with a very short growing season and the entire absence of forest or hinterland considerably lessens the possibility of the introduction of a suitable and profitable second crop. The native farmer throughout the Protectorate is wedded to the cultivation of groundnuts because it is a profitable crop under our conditions and one requiring little labour and no machinery for the growing or preparation of the crop. It is a crop which also admirably suits the mercantile community and one in which there is little danger of over production. For these reasons every possible effort should be devoted to safeguarding and developing this industry. It is however, the duty of this Department to be in a position to introduce and establish other industries should the necessity arise but this should not be done at the expense of the existing crop. Careful consideration has been given to this question for some time past and it is realised that there are very few crops which could be profitably grown without irrigation. An extensive irrigation scheme is at present beyond the resources of the Colony. The most promising second crop at present is Sesame and from the field investigations carried out by this Department it would appear that good yields can be obtained. Two of the five varieties tried appear to be particularly suited to our conditions as the growing period is only 92 days while other varieties require 140 days. The market value of sesame seed is practically the same as that for groundnuts but the yield per acre is much lower and farmers cannot reasonably be expected to undertake the cultivation of any crop giving a monetary return below that of the crop they are now growing and there is no other crop which would prove as remunerative as groundnuts under the existing conditions.

ROSETTE DISEASE INVESTIGATIONS.

Virus disease of groundnuts is undoubtedly the most serious problem at present affecting the groundnut industry and the investigations being conducted by this Department with a view to the ultimate control of this disease have now reached a stage when a review of the information gained and the results achieved may be of service. These investigations were commenced in 1924 and the economic importance of this work becomes evident when it is realised that the whole trade of the Gambia is dependent upon the production of groundnuts which at present forms its sole export crop. The problem is rendered even more serious by the fact that in the absence of extensive irrigation there is little hope of this crop being profitably replaced by another.

The actual losses incurred each year from this disease are difficult to accurately assess but that they are not inconsiderable where infection occurs is beyond all possible doubt.

Lines of Investigation.

The field investigations into virus disease are directed mainly towards elucidating the following points : —

1. What insect is responsible for transmitting the virus in the Gambia ?
2. Study of its life history with a view to ascertaining the most practical means of attacking and controlling it.
3. What are its food plants other than groundnuts ?
4. Devising means of controlling it.
5. Where do early cases of infection come from ?
6. What is the general effect on the crop ?
7. Is infection carried in the seed ?
8. What is the most susceptible period of infection ?
9. What effect if any, has rainfall on the incidence of the disease ?
10. The effect of early and late sowings on the incidence of the disease.
11. Can the degree of infection be controlled by fertilizers ?
12. The possibility of raising disease resistant strains of groundnuts as a practical means of control.
   (*a*) By seed produced by infected plants.
   (*b*) From a variety showing definite resistance to the disease.

Insect Vectors.

The collecting of all insects visiting groundnut cultivation is being continued with the object of discovering the insect carrier of the virus. Among the insects collected are two species of Jassidae belonging to the genus *Cicadulina*. Both of these are reported by Dr. Guy Marshall, Director of the Imperial Bureau of Entomology to be new to science, and the authorities of the British Museum have kindly undertaken to describe and record them. Only two species of this genus were previously known, and as one of these has been proved to carry " streak disease " in maize, it is thought probable that the new species referred to might be carriers of other virus diseases. The insect vector of rosette disease in South Africa is known to be *Aphis leguminosae* Theo. but this Aphid has not been found in the Gambia although much time has been devoted to searching for it. Observations are being continued on these leaf-hoppers with a view to gaining knowledge as to their habits and food plants.

General Effect on the Crop.

Typically affected plants bear a mass of yellow crinkled leaves with shortened internodes causing the plants to resemble a rosette. Affected plants seldom spread beyond six inches and few nuts, if any, are produced. Our investigations show that this disease increases empty shells by 34 per cent. to 55 per cent. This is a very important factor in the groundnut trade as the Gambia crop is sold " undecorticated." It is admitted by the Trade that sound groundnuts are composed of 75 per cent. kernel and 25 per cent. shell and any excess of shell over this proportion is taken as valueless and allowed to the Buyers. The exporters are therefore penalised for this useless increase in bulk and suffer further loss in freightage and cost of handling. Rosette disease further reduces the number of *good* nuts by 43 per cent. to 64 per cent. and the total number of nuts on the individual plant is reduced by 18 per cent. to 24 per cent. Badly infected plants are rendered barren. In one plot where infection was bad the yield was reduced from 584 bushels to 188 bushels.

The Incidence of the Disease.

The incidence of the disease appears to be not unconnected with the date of sowing and the rainfall during the next few weeks. From a number of investigations made on our own farms, and confirmed by comparing with observations on native farms situated in various districts of the Protectorate, it appears that early sowing offers definite advantages over late sowings, although it does not necessarily follow that late sowings will be attacked by rosette disease even if it is present in the district. Our observations tend to prove that if the plants survive the first eight weeks from date of sowing without infection they remain unaffected. The rainfall from the time of germination until the seedlings are about a month old is a most important factor in this question of infection. All our accumulated observations prove most conclusively that infection is considerably greater if germination is followed by comparative drought during the first four weeks of growth. Our rains usually commence at the end of May or early June and the first few wet days are invariably followed by an almost rainless period of 14 to 20 days. Farms planted so that the germinating seed is above ground at the time of this drought are much more susceptible to infection than those farms which are so treated that the germinating seeds appear above ground *after* this temporary drought has passed. The best time for sowing is *during* this drought, as the young plants have then a better chance of developing before the end of July and August when the carriers of the virus appear to be most active. The intervals between the time of sowing and the first appearance of disease vary considerably, but the actual dates of the appearance of disease on farms planted on various dates appear to be within a period of 10 to 12 days. Infection generally commences with one plant becoming infected and this usually occurs near the outer edges of the farm. This plant then becomes a centre from which the disease is spread. The nature of this spread most strongly supports the view that it is insect borne.

A single infected plant has been found growing in a plot surrounded by plants which remained healthy throughout the growing period while frequently there have appeared other small infected areas within the same plot from which the disease has spread from the centre. In cases where these patches were weeded out no further extension of the affected area occurred. We have also recorded that in some cases even where the infected plants have been left undisturbed the spread has not extended beyond a few plants. On the other hand cases have been under observation where areas of several acres have been thoroughly infected. In such cases it is assumed that the carrier must have been particularly active and in proportionately large numbers at some early stage of the growing period. Instances have also been recorded where two kernels in the same shell have germinated and been allowed to develop together. One plant has become infected soon after germination and although both were allowed to remain the other plant remained healthy and produced its normal crop of nuts. Numerous trials have been made under control conditions of raising plants from seed obtained from infected plants. In every case the stock obtained in these trials remained healthy and bore their normal crop. The possibility of infection being carried in the seed, as is the case with virus diseases of potatoes, is a most important point in view of the fact that about 800 tons of groundnut seed is selected and distributed to the farmers by this Department annually. I venture the opinion, however, that we have fairly well established that infection is not carried in the seed or soil.

Methods of Control.

Until further investigations have cleared up certain points which are still obscure, the most important being the identification of the carrier, or carriers, of the virus so that their life history may be studied with a view to determining the best means of attacking it, the most practical methods of control are (i) The immediate destruction of all germinating groundnuts left in the ground from the previous season's crop. A very high percentage of these plants are frequently found to be infected. Moreover it would appear from the accumulated observations that it is chiefly by this means that the disease is carried over from one year to another, although there is the probability that other host plants may exist either in cultivation or in the bush. The destruction of all self-sown plants should, however, be the first aim in control and this will very considerably reduce the area of possible infection. (ii) Early sowing offers distinct advantages over late sowing. By early sowing it is not intended that this should take place immediately the rains commence, as I have previously pointed out, the first few days of rain are invariably followed by a drought of about two weeks before the general rains begin. The aim should be to get the crop sown during this drought so that the plants may come away unhindered as soon as the general rains set in. The seedlings then suffer no check and the rain renders the insects less active. (iii) Rogueing throughout the growing period is by far the most effective way of controlling this disease at present. This considerably reduces the yield but it is probable that the actual loss in yield would be much greater if the infected plants were allowed to remain as a centre of further infection. Some idea of the extent of rogueing which is at times necessary is shown by the following example. On one of our seed farms where infection occurred in an area of approximately nine acres the following number of plants were rogued during a period of three weeks—September 1st to 21st—81 plants the first week, 205 the second week, and 1,360 during the third week. The maximum in any one day being 340 on September 20th and the minimum being one on September 10th.

Effect of Fertilizers on Raising the Natural Resistance of the Plant.

The results shown by the manurial trials over a period of four years tend to show that while phosphatic fertilizers do raise the natural resistance of plants to disease their application is without any marked effect in the case of virus disease of groundnuts. Rosette infection occurred in all the manurial plots and the degree of infection varied from 5 per cent. to 75 per cent. Full details of these investigations are given in the appendices to this report under "Notes on Groundnut Manurial Experiments." The possibility therefore of controlling this disease by the application of special fertilizers is ruled out.

Isolation of Resistant Strains or Varieties.

It was considered that whatever the insect vector may eventually prove to be, the best means of controlling this disease would probably be by discovering resistant varieties, rather than waiting until the insect carrier had been found and its life history worked out. Field experimental trials were commenced for the purpose of testing out all available varieties.

The following varieties are undergoing extensive trials both at Cape St. Mary and on our various seed farms in the Protectorate.

"Basse." Selected in 1923 by the writer after a complete tour of the Protectorate as being the most promising variety observed growing among the native farms.

" Gambia." A characteristic type commonly grown throughout the Gambia.

" Philippine Red." Introduced from the Philippine Islands in 1923 from the stock raised from this variety, two distinct varieties were isolated one of *erect* habit and producing pink seed was named " Philippine Pink " and the other of *trailing* habit producing white seed named " Philippine White."

Five varieties were obtained from Senegal :—

" Baol," " Jaol," " Cayor," " Senegal " and " Sine."

Seven varieties were obtained from Southern Rhodesia :—

" Java White," " Natal," " Virginia Runner," " Virginia Bunch," " Valencia," " Jumbo " and " Improved Spanish."

The " Zaria " variety was introduced from Nigeria and " Mauritius " from Mauritius.

From the results of field trials and observations some very promising varieties have already been obtained. The three best being " Basse," " Philippine Pink " and " Philippine White." In numerous trials on several of our seed farms these varieties have repeatedly given definite evidence of resistance to virus disease*. These are being further tested and special efforts made to increase the stock from these varieties for general distribution.

It frequently happens in plant life that varieties showing a marked degree of resistance to disease are unsuitable as commercial types. In the case of these three varieties we are particularly fortunate however, that they have proved to be excellent commercial types both in yield and in the quality and quantity of the oil produced as shown by the following analyses :—

Variety.	Yield per acre in lbs. Dried Nuts.	Average Weight of 100 Kernels. grms.	Kernels. %	Husk. %	Oil M.F. Kernels. %	F.F.A.
Basse	2,832	56·02	78	22	51·8	0·15
Philippine Pink	2,721	60·62	76	24	50·9	0·15
Philippine White	1,932	67·52	75	25	52·4	0·65

Summary.

1. The insect carrier does not appear to be the same as in South Africa as *Aphis leguminosae* has not been found in the Gambia. One, or both, of the new species of Jassidae which are being determined may prove to be the vector.

2. The insect carrier appears to be most active between the middle of July and the middle of August, judging from the appearance of the disease.

3. So far no food plants other than groundnuts have been observed.

4. Control at present depends upon (i) the destruction of all plants showing any signs of the disease, (ii) the destruction of all germinating groundnuts between the growing seasons, (iii) sowing the general crop to avoid as far as practicable drought during the first few weeks of growth.

* See Mr. Hayes' report on "Provincial Seed Farms" in Appendices to this report.

5. Infection is undoubtedly carried over from year to year by groundnuts left in the ground from the previous season. It is probable, however, that this is not the only means of infection.

6. The plant is stunted in growth. Empty shells are increased up to 55 per cent. Good nuts are reduced to 36 per cent. and in some cases the infected plants are rendered barren.

7. All our evidence goes to prove that infection is not carried in the seed.

8. The most susceptible period is the first few weeks after germination.

9. Rainfall appears to have a beneficial effect on the incidence of disease ; probably by rendering the insect carrier less active. Particularly is this the case during the early stages of growth of the plant.

10. Early sowings, late June or early July, possess advantages over later sowings.

11. Fertilizers individually or in combination appear to have no effect whatever on the incidence of the disease.

12. Three varieties viz :—" Basse " ; " Philippine Pink " and " Philippine White " have been raised which have shown a definite resistance to this disease both when grown in individual plots and when the seed of these three varieties have been mixed with the seed of other susceptible varieties and all grown together in the same plots. These varieties are being grown in bulk and are being distributed to the farmers for general cultivation. No case of absolute immunity has yet been obtained but these three varieties are highly resistant and efforts are being continued towards raising further resistant strains.

SHIFTING CULTIVATION *VERSUS* ROTATION OF CROPS.

The attitude adopted when formulating the agricultural policy of this Department at its inception five years ago was to keep an open mind and to thoroughly test local practices before amending or condemning them. In view of the peculiar climatic and general conditions appertaining locally it was also strongly felt that the experience gained in other Colonies and the results of agricultural investigations in other parts of the world would need to be carefully tested and verified by actual experiment in the field before they could be advocated for general adoption in this Colony.

Being a new department and a country in which there was no permanent cultivation there were no records or reliable information on any of the problems to be dealt with. Such conditions rendered it necessary that the whole policy of the Department should be one of investigation rather than of demonstration. The situation was rendered more difficult by the fact that the climate owing to its short rainfall of five months permitted only one export crop to be grown with any degree of success and the soil being of the light sandy type was easily exhausted.

Shifting cultivation is practised by every farmer throughout the Gambia, and in this way the annual crop of from 60,000 to 70,000 tons of groundnuts is produced. Its disadvantages are too well known to economists to need detailing here but until a practical and profitable remedy has been found it must be allowed to continue. The problem of avoiding it and the means of maintaining fertility has been one of the investigations carried out by this Department since its inception in 1924.

The experimental field work at Cape St. Mary was designed with a view to obtaining reliable information on this difficult problem. The results to date show conclusively that groundnuts cannot be grown continuously on the same land even when the maximum application of complete fertilizer is applied annually and the whole of the vines from the crop are turned in. The humus content of the soil is the crux of the problem. The rainfall is not of sufficient duration to enable large quantities of vegetable matter to decompose readily on the surface and the texture of the soil, which is almost drifting, renders it impossible to plough sufficiently deep to bury it owing to the Tractor not being able to get sufficient grip on the loose surface. "Adco" trials have been in progress for three years with a view to solving this problem, but the results are not yet conclusive. A green manure crop every three years will probably prove the most effective way of maintaining fertility generally but to get the native farmer to grow a crop solely for the purpose of feeding his land and to have that generally adopted will prove difficult when he can at present wander from place to place, cutting and burning down trees and bush. More details of this work are given in the sections "Notes on Groundnut Experiments, 1924–1927" and "Groundnut Varietal Trials, 1927" which form appendices to this report.

PROVINCIAL SEED FARMS.

A report of the work undertaken on the Provincial Seed Farms has been prepared by Mr. Hayes and appears in the Appendices to this report. Mr. Hayes, who has been in charge of these farms throughout the year, has done excellent work under difficult conditions. His deductions have been carefully made and are reliable and of much value. Labour is still the most difficult proposition as we have to depend solely upon casual labour. All farmers are busy on their own farms at the time when planting operations have to be carried out on the farms and the type of labour available for work on these farms is such as would not be employed under more favourable conditions. The chiefs are in most cases willing to bring labour to work these farms *after their own farms are planted*, but this is unsatisfactory owing to our short growing season. It also appears to the individual farmer as being *forced* labour and for this reason it is not employed except as a last resource.

Good land was, and still is, extremely difficult to get without dispossessing others and for this reason the land on nearly all these farms will require some years of careful farming to bring it up to a standard fertility. These farms are scattered over a distance of nearly 300 miles and represent all the varying conditions found throughout the Protectorate. This covering of so large an area considerably increases the difficulties of supervision, but there are distinct advantages to be gained. In this connexion I would draw special attention to the fact recorded in Mr. Hayes report that "at none of the farms were any 'Philippine Pink' plants attacked by Rosette" although this disease was present on every farm and in some cases the yields were considerably reduced by it. Had these farms been confined to any particular part of the Protectorate instead of covering every Province this resistance to virus disease shown by the "Philippine Pink" variety would not have been nearly as valuable, or reliable as it might have been attributable to some purely local conditions. These farms were started in 1926 for the purpose of testing out new varieties of groundnuts with a view to ascertaining their suitability to the particular district and soil, and to determine their resistance to disease. Also for the multiplication of these proved varieties for general distribution.

The work carried on at these farms must necessarily be *investigational* rather than *demonstrational* for some years, but it is hoped that in time they will become agricultural training centres for the districts they serve.

Ninety-three tons of seed from selected varieties have already been raised and distributed. The progeny of this seed is beginning to find its way into the main crop.

MANURIAL TRIALS.

The manurial trials which were commenced in 1924 have been concluded and a review is given by Mr. Pirie, Agricultural Superintendent, in the appendices to this report.

These trials have clearly demonstrated that fertilizers alone will not maintain fertility under continuous groundnut cultivation for a longer period than three years, even though the land had been previously fallowed for eight years and is rested for six to seven months each year.

The general lack of humus in the Gambia soils is shown and the absence of humus is an important factor in soil economy. A rotation with a suitable green manure crop which would provide cover for the soil during the rainless period, November to June, would undoubtedly be beneficial. To induce the native farmers to generally apply such methods will require tact, patience and perseverance.

NATIVE FOOD CROPS.

Importation of New Varieties.

Twenty-three of the best commercial varieties of sorghum obtained from the United States Department of Agriculture were planted with a view to introducing them into general cultivation should they prove superior in yield and disease resistant to our local varieties. Owing to the general exhausted condition of the soil in which these were grown and the poor germination which resulted, no reliable information could be obtained as to yields. They appeared, however, to be more resistant than our local varieties to the attacks of *Aphis Sorghi*, which usually destroys the larger grained varieties of " Basso." With our limited growing season of five months early ripening is an important factor, and in this respect the introduced varieties appear to offer great promise, the earliest being harvested a few days earlier than the earliest Gambian variety and the latest being considerably earlier than the latest local variety. A great drawback to the Gambia varieties is their length of stalk ; the introduced varieties were in most cases more dwarf and carried heavier heads of grain. The most promising varieties were " White African Sorgo," " Chiltes," " Leoti Red," " Dwarf Hegari," " Blackhull Kaffir," " Sumac Sorgo " and " Black Amber." Other varieties tried were " Dwarf Kaffir," " Straightneck Milo," " Freed Sorghum," " Sourless Sorgo," " Early Sumac," " Premo Sorgo," " Darso Sorghum," " Honey Sorgo," " Spur Feterita," " Feteriata," " Dwarf White Milo," " Early White Milo," " Yellow Milo " and " Dwarf Yellow Milo." Seed has been reserved of each variety for more thorough trials during the coming season.

View in Botanic Gardens, Cape St. Mary.

View in Plant Nurseries, Cape St. Mary.

A Riverside Wharf, River Gambia.

Notes on Coos Crops for 1927.

"Basso." Generally good throughout Protectorate owing to the heavy rains keeping the Aphid which causes "Leo" disease in check.

"Kinto." Good in lower river but not so good in the Upper river.

"Suno." Generally poor.

"Saynio." Crop very poor throughout. Excessive rain caused a good deal of damage.

"Majo." Fairly good.

"Maize." Generally good.

"Findo" Generally good

"Rice." A good year for rice in most Provinces.

AGRICULTURAL EDUCATION AND TRAINING.

Armitage School.

Agricultural instruction forms part of the Armitage School Curriculum and a good start has been made. A brief report on the work done has been prepared by Mr. J. Sparrow, Agricultural Superintendent, and is included in the Appendices to this report. The instruction is of a very elementary nature and is made as practical as possible. The boys take a keen interest in their outdoor work and the garden presented a very businesslike appearance upon my recent visit, the beds being well stocked with a varied supply of vegetables from the sale of which money was being obtained for the purchase of sports requisites. It is hoped that this school will in time be able to supply suitable youths for filling the junior agricultural vacancies in this Department.

Agricultural Station Cape St. Mary.

A number of youths, some taken upon their leaving school, and others upon completing their time in the Royal West African Frontier Force have been selected and given employment at this station with a view to training them as gardeners and overseers. Satisfactory work has been done by these youths and it is hoped that they will in time become reliable field officers.

NURSERIES AND PLANT DISTRIBUTION.

The plant nurseries have been maintained in good condition throughout the year. There is an increasing demand from the Chiefs and Headmen for fruit trees and this demand is being met. Large quantities of ornamental shrubs and flowering trees have been distributed to Government bungalows to improve the surroundings.

The following table shows the plants, cuttings and seeds distributed from the Departments' nurseries during the last four years.

Plants.	1924.	1925.	1926.	1927.
Economic Trees	704	677	1,784	273
Fruit Trees	—	—	2,748	2,483
Flowering Trees	77	129	290	72
Ornamental Shrubs	788	1,867	702	882
Cuttings :—				
Sweet Potatoes	825	—	1,600	1,500
Seeds :—				
Groundnuts, bushels	240	7	833	4,033
Corn, bushels	24	—	—	63
Vegetable Seeds, packets	52	32	29	41

CORRESPONDENCE AND DISTRIBUTION OF INFORMATION ON AGRICULTURAL MATTERS.

Registered communications numbering 1218 were dealt with at the Director's office during the year. These included reports on various subjects and 185 minute papers.

Expenditure and Revenue, 1927.

The votes of the Department of Agriculture for the year under review were as follows :—

	£
Personal Emoluments	4,232
Sea Passages	271
Transport and Travelling Allowances	500
Miscellaneous Requisites	100
Scientific Apparatus	70
Plants, Seeds, Fertilizers, Chemicals for Plant Disinfection	400
Labour	1,520
Technical Library	10
Tools, Implements and Machinery	125
Uniforms	85

The actual expenditure for the year was £6,915 3s. 4d., being £397 16s. 8d. below the approved estimate.

The revenue derived from sale of Plants and Seeds was £825 18s. 8d.

GOVERNMENT HOUSE GROUNDS.

Some assistance has been rendered by this Department, working in co-operation with the Public Works Department, in improving the general appearance of Government House Grounds. These grounds had become very unsightly and were overgrown with trees and shrubs of little ornamental value. The more unsightly trees have been removed and a small grass lawn surrounded with a flower border has been established with Bermuda grass "Cynodon dactylon." A large number of English flowering annuals were raised for planting up these borders and a number of ornamental beds have been laid out and planted with ornamental shrubs.

IMPERIAL AGRICULTURAL RESEARCH CONFERENCE.

I represented the Gambia at the Imperial Agricultural Research Conference which sat in London from 4th to 13th October and moved to Cambridge from 14th to 18th and then on to Edinburgh, Aberdeen, and Belfast returning to London on 23rd October to continue in Plenary Session until the 28th. From 29th October to 11th November special visits were made to the various research institutions in London, Harpenden, Oxford, St. Albans, Wisley, Merton, Bristol, Aberystwyth and Bangor. I greatly appreciate the unique opportunity which this conference afforded of acquiring valuable experience and information relating to many of our local problems. To the Colonial Delegate the greatest value of this Conference was perhaps the opportunity it gave of getting into close personal touch with workers on similar problems in other parts of Empire and of discussing with them the results of their latest investigations. In my own particular case I consider that the discussions which it were possible for me to take part in with specialist research officers on such subjects as Virus diseases, the Maintenance of Fertility in Tropical Soils, and the latest Methods of Control of Cattle diseases such as Contagious Pleuro-pneumonia were of the greatest value to this Colony.

Conference between the Director of Agriculture and the Merchants Established in the Gambia held at Africa House, Kingsway, London.

A meeting of the Merchants established in the Gambia was arranged and attended by the Director of Agriculture on 11th November for the purpose of reviewing the work done by the Department and for ascertaining the views of the Merchants upon agricultural and trade development in the Colony. The chair was taken by Col. Nicholl, Chairman of the African Section of the Liverpool Chamber of Commerce, and was attended by the following representatives. Mons. Joseph Maurel (Messrs. Maurel Freres); Mons. Henri Prom (Messrs. Maurel & Prom); Mons. S. Vezia (Etablissements Vezia); Mons. G. Barthes (Messrs. Barthes & Lesieur); Mons. E. Deresse (Compagnie Française de l'Afrique Occidentale); Mons. Arnaud Faure (Produce Broker); Mr. W. T. Norton (Messrs Palmine Limited); Mr. V. B. Powis (Bathurst Trading Co. and Gambia Trading Co.); Mr. T. Jaynes (African & Eastern Trade Corporation Limited).

The meeting recorded its approval and appreciation of the efforts being made to further trade and assured the writer of their ready co-operation and support.

STAFF CHANGES.

The Director of Agriculture proceeded on leave on July 8th and returned to the Colony on December 30th. During his absence Mr. C. W. Line performed the duties of Acting Director.

Mr. J. W. Sparrow, Agricultural Superintendent, left for England on 6th May and returned on 8th September.

Mr. T. R. Hayes, who was on leave in England at the beginning of the year, returned on 3rd April.

Mr. C. W. Line, Assistant Director of Agriculture proceeded to the Canary Islands on Local Leave on April 21st, and returned on 16th May. This officer left for England on 20th January and is still away on leave.

Mr. J. Pirie, Agricultural Superintendent, proceeded to England on 2nd March and is still absent on leave.

Mr. K. O. Kamara, Native Interpreter, was retired on medical grounds during the year.

Agricultural Overseers, Jacob Bruce and Famara Sonkor, were dismissed for incompetence and replaced by Secku Camara and Sanosi Camara.

METEOROLOGICAL REPORT FOR 1927.

DEPARTMENT OF AGRICULTURE, THE GAMBIA.
HOURS OF OBSERVATION 9.00 A.M.

Station Cape St. Mary. 16″ 40′ 24″ 13″ 29′ 04″ H.52·31.

Months.	Air Temperature							Dew point.	Elastic force of vapour.	Relative Humidity Sat., 100.	Wind velocity in miles p.h.	Rainfall. ins.	No. of days in which rain fell.
	Means.		Range.	Absolute.									
	Max.	Min.		Max.	Date.	Min.	Date.						
January ...	83	63	20	94	1st	60	31st	56·70	0·463	55	—	—	—
February ...	85	60	25	95	21st	62	21st	52·10	0·390	48	4·33	—	—
March ...	82	64	18	100	2nd	62	13th	63·0	0·576	66	6·38	—	—
April ...	85	67	18	100	1st	58	9th	62·7	0·571	58	10·43	—	—
May ...	84	70	14	88	24th	66	2nd	69·9	0·732	72	8·40	0·54	3
June ...	85	74	11	87	10th	72	10th	72·0	0·785	72	7·28	8·10	8
July ...	85	73	12	88	9th	68	11th	75·3	0·877	80	6·05	10·86	16
August ...	83	—	—	87	22nd	—	—	73·9	0·839	85	3·57	28·99	25
September	85	—	—	89	6th	—	—	73·3	0·820	80	4·48	19·05	21
October ...	87	73	14	90	9th	67	20th	77·0	0·926	85	5·01	5·42	13
November...	87	74	13	93	16th	69	29th	68·0	0·684	62	6·61	4·03	1
December...	84	68	16	93	20th	65	31st	62·1	0·526	56	8·04	0·04	1
Totals ...	1,015	686	161	1,104	—	649	—	806·0	8·189	819	70·58	77·03	88
Means ...	84·7	68·6	16·1	92·0	—	64·9	—	67·1	0·682	68·3	6·41	—	—

Main Sea Level determined from readings taken at gauge, Bathurst, over periods January 1st to December 31st, 1926.

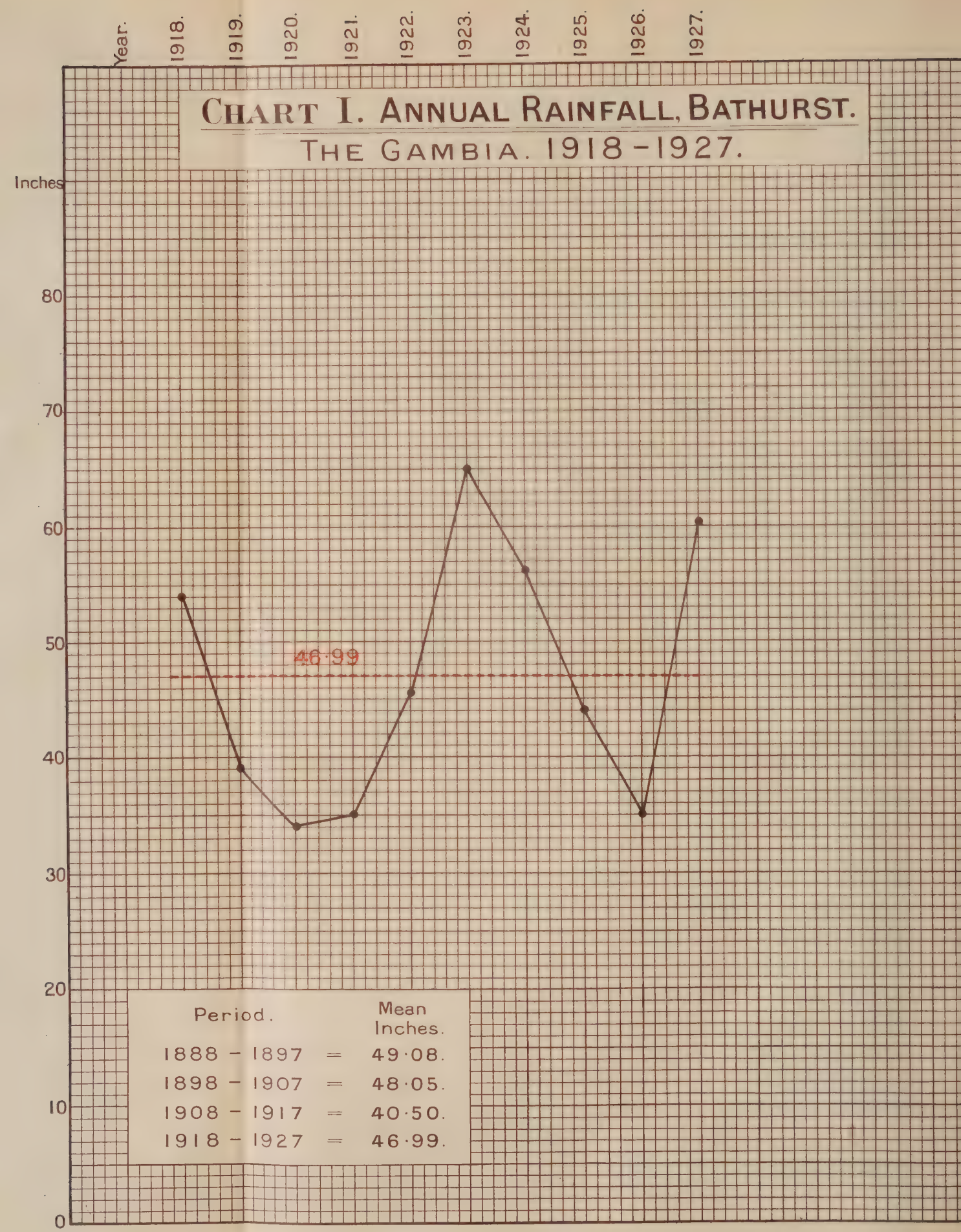
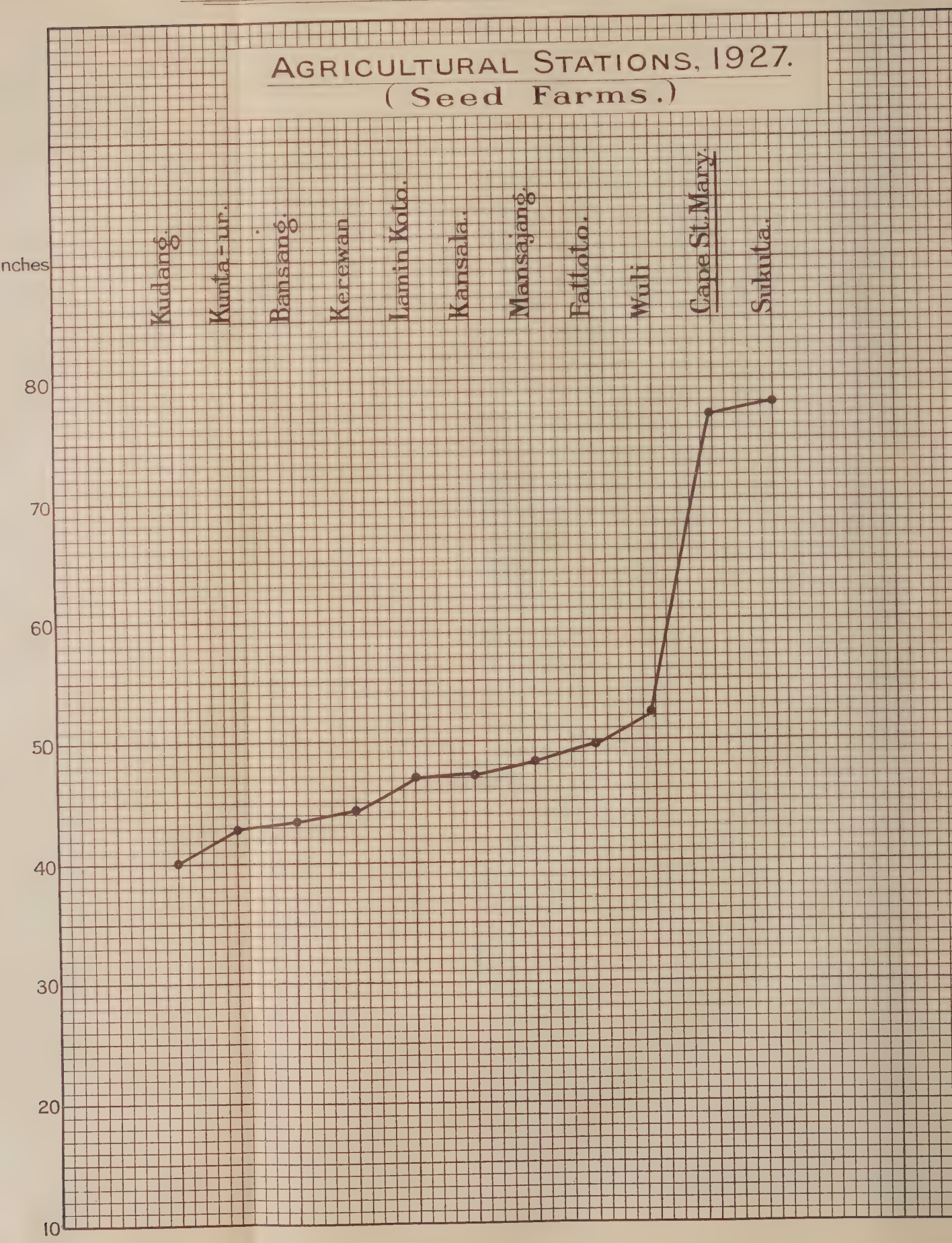

Year.
1918.
1919.
1920.
1921.
1922.
1923.
1924.
1925.
1926.
1927.
CHART I. ANNUAL RAINFALL, BATHURST.
THE GAMBIA. 1918 - 1927.
Inches
80
70
60
50
40
30
20
10
0
46·99
Period.
Mean Inches.
1888 - 1897 = 49·08.
1898 - 1907 = 48·05.
1908 - 1917 = 40·50.
1918 - 1927 = 46·99.

CHART II. ANNUAL RAINFALL AT THE



METEOROLOGY.

The following are summaries of the observations recorded at the Agricultural Station, Cape St. Mary, for the period commencing January 1st and ending December 31st, 1927.

Rainfall.—The rainfall for the year was 77.03 inches being 42.10 inches in excess of that recorded for the previous year. The first shower fell on May 26th and the last on November 5th when 4.03 inches were registered which was the heaviest fall for any one day throughout the rainy season.

The Annual Rainfall for the last decade is shown in the following chart and among the Appendices is published the Annual Rainfall from 1888 to 1927. A detailed statement is also given of the monthly rainfall at each of the recording stations throughout the Protectorate during 1927.

Wind.—The mean daily velocity of the wind was 6.41 miles per hour. The highest maximum recorded over a period of 24 hours was on May 8th when 24.45 miles an hour was registered. From January to May the wind blows from N.E. and N.W. During the months of June to October it blows from S.W. or W., and from N.E. during November and December.

Temperature.—The mean maximum temperature for the year was 84.7° being 4.1° below that for the previous year. The mean minimum was 68.6° being 2° below that for the previous year. The hottest months of the year were October and November when the mean maximum was 87°, this being 6° below that for 1926. The extreme maximum temperature was 100° recorded on two occasions, viz., March 2nd and April 1st, this being 5° below the maximum for the previous year. The extreme minimum 58° was recorded on April 9th, being 3° below that for the previous year.

Humidity.—The mean relative humidity for the year was 68.3 per cent. being 3.3 per cent. greater than during the previous year. The range being from 48 per cent. for February to 85 per cent in August and October. The usual detailed Meteorological Report for 1927 is included in the appendices.

CONCLUSION.

The thanks of the Department are again due to the following for valuable assistance rendered during the year. The Director, Royal Botanic Gardens, Kew; Director, Imperial Bureau of Mycology; Director, Imperial Bureau of Entomology, and the Director, Imperial Institute, London.

I further desire to acknowledge the loyal assistance rendered by all members of my staff, both African and European, throughout the year.

ARCHIBALD J. BROOKS,

Director.

June 8th, 1928.

APPENDIX I.

PROVINCIAL SEED FARMS AND DEPOTS.

(Submitted by Mr. T. R. Hayes, M.Sc., Agricultural Superintendent.)

The Seed Farms during 1927 were again devoted almost entirely to Groundnuts. With the exception of Fattoto, Lamin Koto and Bansang, every farm showed a decreased yield, compared to that of 1926. The three farms Wuli, Mansajang and Kuntaur, showed a big decrease, due to Rosette disease. In the other cases the reduction may be due to planting the same crop twice in succession. The best land for groundnuts is that described in the recent Geological report as " Plateau or elevated Sandy plain." The farms at Sukuta, Kansala, Soma, Bansang and Fattoto are on this type of land, and the crops from these farms in addition to being good in yield, compare very favourably with the other farms, for quality. The remaining farms are on land near the river known as " undulating sandy hills " where erosion has obliterated the original surface soil. The Geologist states that these two types of land appear equally fertile, but this seems open to doubt. It was necessary to have the farms near the river, both for convenience of transport in connection with the seed distribution scheme and for supervision. Further it is better to investigate poor land in need of it, than to show good yields on land in less need of investigation.

Staff.

In the previous Annual Report, comment was made on the unsuitability of the " Clerk " type of Overseer. Three of these were replaced by time expired soldiers, who were brought up " on the land " and yet could be relied on to carry out instructions. These men have proved satisfactory. The " Clerk " type of overseer has in general again proved useless, in fact, he sometimes makes work for the European in charge instead of relieving him of it. He expects and receives a higher salary than the others and he thinks it undignified to work with his hands. His sole qualification is that he can read and write English, and so is more useful on Inspection work ; but even there he is not always reliable.

It is hoped that the boys now in training at Cape St. Mary and at the Armitage school will prove the final solution of this problem.

Labour.

The policy laid down was that as far as possible labour should not be employed through the Chiefs, but that when permanent labourers were not employed, the people of the neighbouring towns should be induced to work the farms by contract, and of their own free will. In most cases, contracts were made by the young men's societies. A certain amount of suspicion was evident at first, owing to the fact that during the previous rain season the work was done through the Chiefs. When a Chief is asked to perform certain work, he calls out many more men than is necessary, bringing them sometimes from towns several miles away ; a man spends two or three hours walking to and from the work, which is finished in a few hours owing to the number employed ; by the time the man has greeted all his friends from the

other towns present, and returned home, it is not worth while going to his own farm. He thus gets threepence or sixpence to compensate him for a day's absence from his own farm. Further, a man prefers to work freely for a 1s. than to do the same amount of work under compulsion for 2s.

Later in the season, when the young men found that each of them was getting reasonable pay for his work, for the most part they worked readily. This success was also due to the friendly attitude of the Chiefs.

At four farms the work was done through the Chiefs. The work was well done, and the officer in charge relieved of much trouble.

Day Labour versus Contract Work.

At one farm, with a good overseer and men, the work was mostly done by day labour, and it proved to be more expensive than contract work. The reason is that when groundnuts alone are grown, there are times when there is no work to be done, and other times when extra help has to be called in to cope with the work. As the labourers have no farms of their own, it would be unfair to dismiss them during the slack periods ; in fact if that was done we would have difficulty in getting men when next there was work to be done.

THE FARMS.

Fattoto.—Half the farm was planted in the flat way and half was ploughed. A section of each was devoted to Philippine White, the remainder being sown with Gambia and Zaria seed. About half an acre was planted with " Philippine Pink." This farm did much better than the previous year, but it should be noted that previously the lack of transport and illness of the Overseer militated against the success of the farm. Rosette disease appeared in one corner of the field, but the infected plants were ruthlessly weeded out and the disease did not spread.

Wuli.—This farm has comparatively virgin soil, and last year gave the highest yield. This year it was badly attacked by Rosette disease. Hundreds of plants were pulled up, but the disease took its course, and the resulting yield was very poor. The quality of the healthy groundnuts reaped was fairly good. The farm was not planted until July 18th, which was later than usual. *About half an acre of Philippine Pink, planted at the same time, was practically immune to the disease.*

Mansajang.—Planted at intervals between June 28th and July 22nd, Rosette disease appeared, varying in severity with the date of planting. The only part unaffected was that devoted to " Philippine Pink," but this part was planted first, which factor would assist it to withstand the disease. All infected plants were pulled up and burnt during the first month of the incidence of the disease. A section was planted with " Philippine White," but this germinated badly ; there was insufficient white seed for replanting and Gambia seed was used. The plants from the latter were badly attacked by Rosette, while the " Philippine White " was hardly affected.

Bansang.—This farm is situated on an ironstone ridge. The land produces good groundnuts, but cultivation is difficult and yield reduced by the stone. In a season of light rainfall, this farm would suffer more than others from drought. "Philippine Pink" was poor. "Philippine White" did well. A small patch of Rosette occurred, but this was weeded out, and no more disease appeared.

Famin Koto.—For two years this farm has been affected by Rosette. The only advantage of this land is that it is so poor that weeds find it difficult to grow, and only two weedings were necessary. The quality of groundnut produced is poor, and instead of the seed improving each year, it is degenerating. The soil is a fine silt, which is sodden after rain, and which, after a few days fine weather, bakes as hard as a brick, giving the Rosette disease just the dry conditions favourable to its progress. A heavy dressing of humus would improve the texture of the soil, but lavish expenditure would be necessary.

Kuntaur.—The later plantings at this farm were affected by Rosette disease, the same procedure as above being adopted to check it. Most of the ground here is the reverse of that of Lamin Koto. It is rich and black, and the weeds grow very quickly. A year or two of coos would put this farm in good condition for groundnuts. The labour difficulty here was acute.

Kudang.—Germination on this farm was poor, although conditions were good. At the second sowing conditions were unfavourable. The soil appears to be quite suitable for groundnuts, and the standard of cultivation was fairly good. This farm should produce much more.

Kau-ur.—The soil here is similar to that of Lamin Koto, being very near the rice farms. The yield may therefore be considered comparatively good. No Rosette disease appeared, and Leaf Spot, which affected many farms in the district, had only a slight effect.

Soma.—A heavy rain just after sowing caused a temporary stream to flow through the farm and part of the ploughing and sowing had to be repeated. As at Kudang, cultivation and soil were satisfactory and a higher yield was expected. During the absence of the overseer on leave, the late rains wetted the stacks of unbeaten groundnuts, and instructions for spreading and drying were not carried out promptly. 18 cwt. of seed were thus rendered unfit for distribution.

Kerewan.—This land has been cultivated for many years and is worn out. The texture of the soil, unlike that of Lamin Koto, is good, and the soil should be capable of improvement. A quantity of vegetation has been collected and covered in, for application when rotted. The quality, as well as the quantity, of the groundnuts leaves much to be desired.

Kansala.—This land, although very near the river, is good. The farm measures 6 acres instead of the usual 10 acres, and the area is further reduced by the presence of an ironstone ridge. The yield was the second best of the farms, and the quality of groundnuts produced was excellent. This farm was not planted in 1927, except for a small area the land being fallow.

Sukuta.—In 1926 only a part of the farm was planted. Of the land used in 1927, part was previously occupied by thick bush and abundance of other vegetation, indicating rich ground. The remainder had been farmed recently but appeared to be good ground. As at Kudang and Soma, the land should produce more, and at present no definite reasons can be given to explain the matter.

VARIETIES.

The original seed was a mixture of seven varieties or strains, "Philippine White," "Philippine Pink," "Mauritius," "Senegal," "Zaria," "Basse" and "Gambia." In 1926 the Mauritius was eliminated by natural conditions, and the Senegal also but to a lesser extent. The Philippine White and Pink were separated from the rest in 1927 and sown by themselves. The remainder consisted of Basse, Gambia and Zaria; the latter is of the Gambia type, and the mixture is now referred to as "The Gambia."

"Senegal."—Very little of this variety was noticed this year, except at Fattoto where it appeared to thrive.

"Philippine White."—At Fattoto this seed yielded 12 cwts. per acre, against 10½ cwt. for the Gambia seed. At Mansajang it germinated badly, owing to drought soon after planting. The yield was 8.2 cwt. per acre against 9.3 for the Gambia. At the other farms this seed was uniformly satisfactory, although reliable figures as to yields were not obtainable. "Philippine White" is regarded as the best variety we have.

"Philippine Pink."—A small plot was planted at each farm, except at Mansajang where 3 acres were planted. The following figures were obtained:—

Farm.	*Yield (cwt. per acre).*		
Fattoto	6.4	Ground	flat
Mansajang	8.8	„	ridged
Kuntaur	8.7	„	flat
Kau-ur	8.2	„	flat
Sukuta	8.0	„	flat

At none of the farms were any "Philippine Pink" plants attacked by Rosette. At Kuntaur and Kau-ur the plants were badly defoliated by Leaf Spot, but with apparently no effect on the yield. At Fattoto the seed was sown too far apart; being of an upright habit, it should be shown with an interval of four inches instead of the usual six to twelve inches; less weeding is then necessary, and the yield per acre is increased. The difficulty is that when this is done, the hoe cannot pass between the plants without injuring them. This variety showed resistance to Rosette disease and should be suitable for late planting.

"Gambia."—The Yields were as follows:—

Farm.	*Cwts. per acre.*	*Farm.*	*Cwts. per acre.*
Fattoto	11.2	Kudang	7.0
Mansajang	9.3	Kau-ur	8.0
Wuli	4.8	Soma	8.9
Bansang	7.8	Kerewan	3.4
Lamin Koto	8.3	Kansala	10.5
Kuntaur	6.8	Sukuta	8.0

Comments on these yields are made in the remarks on each farm. The quality of seed on each farm was carefully examined, and it was found that the seed at Lamin Koto, Kau-ur and Kerewan was below average, while on the remaining farms the seed maintained a high standard. At Fattoto and Kansala the seed equalled in quality if it did not exceed, the very best produce obtainable. It is important to note that, no matter how excellent a strain may be, it appears to degenerate on poor ground. Farmers operating on poor land should not reserve any of their groundnuts for seed, but should rely on seed obtained from other ground.

FRUIT TREES, Etc.

Only a few additions were made to the permanent trees on the farms; such plants cost money to water in the dry season, and the necessity of economy was emphasised.

The lime plots have been quite successful. At Mansajang, Wuli and Kuntaur farms, where more attention was paid to them, they have done remarkably well. At the other farms the majority of plants have survived lack of water, poor soil or insect pests, as the case may be.

The only way to get the farmers to take up this crop in quantity is to show them that it does not need watering, even during its first dry season. The guavas have done well, and they get over the dry season with a minimum of attention. This tree could be planted along the roads and would provide shade, fruit and wood for hoe handles.

Excellent bananas and pawpaws have been produced at the Mansajang and Wuli farms, and have provided a small source of revenue. At Lamin Koto and Kau-ur these plants do not succeed.

White ants have not troubled us much except at Bansang and Lamin Koto, where watering attracted large numbers to the plants and water had to be withheld. Several hundred economic plants were received from Cape St. Mary and distributed. A number of Banana suckers were also issued from the farms themselves. The people were particularly pleased to obtain Mangoes, and they take much trouble in their cultivation. To eliminate the cost of transport, it is intended to propagate mangoes at one or two of the farms. This will serve the additional purpose of showing the people how to do it for themselves.

In certain districts very little cassava is grown. To stimulate interest in this easily grown crop, cassava was interplanted with groundnuts at Soma and Fattoto. A small supply of cuttings will be available next rain season for free distribution; these will be used to demonstrate the making of cassava flour.

With the same objects in view a small patch of sweet potatoes was planted at each farm. The scope of this plant is limited, as the crop is reaped when there is plenty of other food, and it will not keep until the first rains, when food is scarce.

EDUCATION.

A number of meetings were held by the Director just before the rains to encourage the farmers to plant larger areas and to remind them of the importance of seed selection. As a result of this, one of the younger and more progressive Chiefs set an excellent example to his people, and doubled his area under groundnuts. During the rainy season, small informal talks were held in the villages and on the peoples' farms, where opportunity occurred. No large meetings were arranged so that the farmers should not be called from their work.

We have still a long way to go, however. Our advice concerning the rooting up of diseased groundnuts was ignored, although the farmer knows that he will not get any nuts from such plants. Many nuts were stacked on the ground. Energetic measures and subsequent inspection were needed to make the farmers open their stacks after the late rains, and by the condition of some of the nuts which have appeared at the wharf towns, many stacks cannot have been opened at all.

APPENDIX II.

AGRICULTURAL EDUCATION.

The Armitage School.

(Submitted by Mr. J. W. Sparrow, Agricultural Superintendent.)

The school building and pupils' quarters are situated at the Western side of Georgetown, McCarthy Island, and were officially opened by the late Governor, Sir Cecil Armitage, in the early part of 1927.

It was decided that the boys should receive a certain amount of training in Agriculture, and for this purpose a garden has been laid out adjoining the school.

The first object of this garden is to teach the boys the dignity of labour. Manual work combined with discipline and Nature Study being regarded as important factors in developing a boy's character.

All agricultural work in connection with this school is being carried out under the supervision of the staff of the Agricultural Department.

Garden Site.

The site selected for the garden is most convenient and satisfactory, as close proximity is an important feature where school boys are concerned. There is nothing more irksome or vexing for a youngster than being called upon to travel a distance to perform anything that is not in the nature of sport. There are approximately 70 boys attending the school, 40 of whom are borders whose parents are either Chiefs or Headmen of districts and villages throughout the Gambia. The scholars ages range from 4 to 17 years.

Garden Preparation.

The ground was measured and a scale plan drawn up for the general lay-out. Twenty-four beds, each 20 feet by 5 feet were pegged out, and in addition, two large plots were set aside for general experiments and propagating purposes .The beds are separated by paths 4 feet wide which run at right angles from a main centre walk. A 5 feet border surrounds the whole garden which is being utilised for ornamental shrubs and flowers. Several of the older pupils assisted with the work of measuring and pegging out the beds, etc.

Allocation of Pupils.

The beds are lettered alphabetically and four boys detailed to each bed. Boarders and Day-boys alternately. The object being to foster keenness and a competitive spirit. Prizes are to be awarded to the boys whose beds show best endeavour and general neatness.

Preparation of Beds.

This work was somewhat arduous for small boys, as each bed required digging and trenching to a depth of at least 18 inches. Also a large quantity of grass was collected and placed in the pit of each bed. By this method the soil was thoroughly turned over, aerated and drained. Cattle manure was collected and dug in after the completion of the trenching operations.

Having squared and earthed up the beds 6 inches above the path level, iron-stone cobbles of medium size were placed neatly round each bed so as to maintain its shape and uniform appearance.

Seed Sowing.

It was decided to confine the gardening to vegetable culture for the first season, and this would serve the dual purpose of affording material for instruction, and at the same time produce useful food. The rainy season was more prolonged than usual, consequently seeds were not sown until the end of November. Each group of four boys received an issue of the following seeds :—

Beans (var.)	Peas	Lettuce	Turnips
Beetroot	Onion	Tomato	Cabbage
Cauliflower	Egg plant	Celery	Carrot

In addition to these, seed boxes were sown with a further supply of cabbage and tomato seed. The seedlings were transplanted at a later date, into prepared beds reserved for them.

Lectures.

During the hours allotted for garden work the boys received lectures on the following subjects :—

Air and Water.	Seed and Plant structure.	Soil.
Watering.	Weeding.	Manures.
Cultural methods.		

The lectures were delivered in a non-technical manner and were of a very elementary nature as the boys are drawn from small villages where no schools exist.

Sale of Produce.

Seed germination was very fair and the growth of the plants satisfactory. Vegetables were sold locally, and with the proceeds it is proposed to purchase sports gear for the recreation of the scholars.

APPENDIX III.

NOTES ON GROUNDNUT MANURIAL EXPERIMENTS, 1924–1927.

(Submitted by Mr. J. Pirie, Agricultural Superintendent.)

These experiments were started during 1924, the original intention being to carry them over a period of five years, but as the primary object in all field work is economic, it is more convenient to draw final conclusions now.

History of the Land.

It is known that the land was under a groundnut crop during 1923 and that it lay fallow for eight years previously owing to its being occupied by the Admiralty Wireless Station. The whole area was fenced in during its occupancy by the wireless station and cattle were not allowed inside and the soil was not cultivated for that period.

It has been difficult to get accurate information about the cropping before the wireless station was erected, but it was probably heavily cropped owing to its close proximity to two villages. For the same reason it is very probable that cattle were tied up during the night more or less continuously throughout the dry seasons.

Before the erection of the wireless the soil was a fair sample of normal cultivated Gambian soil and the eight years fallowing would discount to a great extent the effect of previous crops or standing cattle. It will be seen, therefore, that these experiments were started under conditions as favourable as could be obtained in a country where the native farmer has not a definite system of cultivation and who cultivates an area for an indefinite number of years and then moves on.

Cultivation.

For the 1924 and 1925 crops cultivation was by a small plough drawn by eight men, this method was quite effective but expensive. The plough turned a deeper furrow than the native "darambo." Cultivation for the 1926 crop was by Fordson Tractor and two-furrow plough which, whilst less expensive than the hand plough, did not turn the furrow over as cleanly.

The Tractor broke down at the commencement of the 1927 season, and, speed being essential, the soil was forked. Except for speed this method has nothing to recommend it, especially in a sandy open soil such as these experiments are being carried out in. Seeds and weeds were not buried, with the result that weeding operations had to be started almost as soon as the nuts germinated. In addition, the soil loses a certain amount of humus. This loss of humus from forking may possibly have had some light effect on the 1927 yields, but any loss in weight from this cause must have been negligible.

In order that decaying weeds should not effect the yields, they have always been carefully removed when the land was cleaned.

The Gambian native farmers have two methods of preparing the soil for groundnuts. The Mandingoes make ridges and plant on top of the ridge, whereas, the Jollofs turn the soil over more after the manner of an ordinary plough and plant on the flat. As far as could be seen when travelling in the Protectorate both are equally suitable.

The flat method was, of necessity, adopted for these experiments and the seeds planted 18 inches by 6 inches. The seeds were shelled and only the best used. The amount being 40 lbs. to the acre. From planting to harvesting three weedings have been necessary and to prevent seeding, the land was always cleaned after the crop was harvested.

Rainfall.

During the four years under review the rainfall has varied considerably. The meteorological instruments did not arrive in time for complete records for 1924 to be made, but the Bathurst records, 7½ miles distance, can be used for that season.

Year.	Inches.
1924	56.46
1925	53.56
1926	34.93
1927	77.03

The totals for seasons 1924 and 1925 may be taken as being equally favourable to plant growth, but the interesting and important point is that the rains were heavier during July of 1924 than for the same month of 1925.

1924 ... June 2.98, July 13.85.
1925 ... „ 3.32, „ 4.26 a difference of 9.25 inches.

It will be noted that this difference occurred before August. June, 1925 gave sufficient rain to warrant planting whilst July gave just sufficient to keep the plants going. This difference has to be noted here but will be referred to later when dealing with resistance and susceptibility to disease

The yields for 1925 were the highest throughout the series. The 1926 season, with a rainfall considerably below the average and extended periods of drought throughout the growing period, shows a distinct drop in the yields.

During the 1927 season the rains commenced at a very suitable time and continued steadily so that germination and early growth were good, giving every indication of good yields. It is important to note that although 1927 should, with its good rainfall, have given yields at least equal to those of 1924 or 1925, they were much lower. Moreover, owing to the previous years' crop being heavily infected with Rosette disease it was thought advisable to use the " Basse " type for the 1927 experiments instead of the Gambian. This " Basse " type is best described as a good selection of the Gambian and has always given a higher yield in the varietal trials.

The 1927 season was such, that had artificial fertilizers been maintaining the fertility of the soil, high yields would have been returned. At the time of writing the Free Fatty Acid analyses are not available so it is not possible to state what effect, if any, the various fertilizers had in combating or aggravating this evil.

If phosphatic fertilizers are of any use in retarding fermentation, or if nitrogenous fertilizers encourage it, this last season should make these points apparent, as heavy rain fell after the groundnuts had been stacked.

TABLE 1.

PHOSPHATIC FERTILIZERS VERSUS CONTROL YIELDS, BUSHELS PER ACRE.

—	1924.	1925.	1926.	1927.	Average.
Bone Meal	63	65	19	18	40
Superphosphate	36	59	26	28	37
Basic Slag...	48	58	19	22	24
Control (no Manure)	49	67	24	22	40

Standard bushel of 28 lbs. Yields to the nearest bushel.

The above table shows that only one of the three phosphatic fertilizers gave as high an average as the control.

Throughout the whole series there is a sharp drop in the yields for the third year.

TABLE 2.

NITROGENOUS FERTILIZERS VERSUS CONTROL YIELDS, BUSHELS PER ACRE.

—	1924.	1925.	1926	1927.	Average.
Dried Blood	51	73	24	29	44
Nitrate of Soda	—	—	—	—	—
Sulphate of Potash	56	19	8	12	23
Control (no Manure)	49	67	24	22	40

Standard bushel of 28 lbs. Yields to the nearest bushel.

The dried blood plot has given a somewhat higher average than the control and considerably higher than the N/S.S/P. plot. The best year is the second, after which there is a falling off. It would seem that the humus content of the dried blood exercises a considerable influence on the health of the plant.

The percentage of nitrogen applied in the dried blood was not nearly as high as that of the N/S.S/P.

During 1925 50 per cent. of the plants were infected with Rosette disease in the Nitrate of Soda-Sulphate of Potash plot, and in 1926 60 per cent.

A glance at Table 2 shows that, even after an allowance has been made for the total loss of the infected plants, the yield from this plot is still a long way behind the control.

Evidence during 1927 has led the writer to come to the conclusion that the shortage attributed to Rosette disease during the previous two years may have been due to an entirely different cause. Germination was good in this plot as elsewhere during 1927, but immediately after many of the plants ceased to grow and finally died. Many died before forming their first true leaves, others just after the first leaves were formed, and the majority after two or three leaves had developed.

All the plants which lived long enough to form two or three leaves, and those which grew throughout the season, suffered from chlorosis. The plants which were finally harvested remained a pale green colour throughout their period of growth.

Chlorosis being characteristic of Rosette disease during a season when Rosette was general, it was natural to assume that this plot was more heavily infected than the others.

During 1926 other plots were heavily infected with Rosette in varying degrees from 20 per cent. to 75 per cent. (See " Results of Manurial Experiments, 1926.") For 1927 fresh seed was used for all the plots.

If the disease is seed borne, why were the other plots not infected ?

If in the soil, how did the other plots escape in 1927 ?

It is difficult without a soil analysis to give an explanation of what has occurred in this plot. Two theories appear to meet the case. One is that the soil is so acid that the tender young roots were unable to penetrate. The other is that the nitrogen has killed off the necessary bacteria and the plant is unable to live without them. On the other hand the acidity theory seems rather far fetched in a country with eight rainless months in the year and an open sandy soil.

TABLE 3.

Nitrate of Soda and Basic versus Control.

Bushels per Acre.

—	1924.	1925.	1926.	1927.	Average.
Nitrate of Soda	—	—	—	—	—
Basic Slag...	48	57	73	31	42
Control (no Manure)	49	67	27	22	40

Standard bushel of 28 lbs. Yields to the nearest bushel.

The table shows that this combination gave a slightly higher average than the control and again there is a sharp drop after the second year.

TABLE 4.

Complete Fertilizer versus Control.

Bushels per Acre.

—	1924.	1925.	1926.	1927.	Average.
Nitrate of Soda	—	—	—	—	—
Sulphate of Potash	—	—	—	—	—
Basic Slag...	60	54	38	34	46
Control (no Manure)	49	67	24	22	40

Standard bushel of 28 lbs. Yields to the nearest bushel.

This combination has given the highest average yield. A drop in the yield after the second year.

TABLE 5.

Basic Slag, Sulphate of Potash versus Control

Yields per Acre.

—	1924.	1925.	1926.	1927.	Average.
Basic Slag...	—	—	—	—	—
Sulphate of Potash	38	67	17	33	38
Contol (no Manure)	49	67	27	22	40

Standard bushel of 28 lbs. Yields to the nearest bushel.

This combination has produced less than the control and there is still a sharp fall in the yields after the second year.

Summary.

It is necessary to impress on the reader the fact that these notes deal with artificial fertilizers used alone

Weeds have been carefully removed, the only organic matter left in the soil has been the previous year's groundnut grass and this only amounts to sixteen 4-bushel bags per acre, the total weight of which is 432 lbs.

It is extremely difficult in summarising the results of these experiments to balance the effects of the various factors which have had a bearing on them.

Nitrogenous.

Nitrogenous fertilizers are usually applied in order to :—

(*a*) Increase the growth of stem and leaf.

(*b*) Tide the plant over a bad period.

(*c*) To prolong the growing period.

In the case of the dried blood there has been a marked increase in growth but not an increase in yield to correspond.

The Nitrate of Soda Basic Slag plot had no great increase in growth. During the 1926 growing season prolonged periods of drought proved very trying to the plants, but there was no indication that the plots treated with nitrogenous fertilizers suffered less severely than the control or phosphatic plots.

The plants in the nitrogenous plots did remain green a little longer than those of the phosphatic plots, but as an increase in the amount of produce must be the aim in all manuring and the slight prolongation of growth did not produce any great increase in yield, it must be written off as of no importance to the native farmers at this present state of development.

The failure to obtain full value from nitrogenous fertilizers can be put down to the type of soil being dealt with and the rainfall.

In the first place the soil is very sandy and open, therefore when a dry period occurs during the plant's growth the soil dries out so quickly that the plant cannot avail itself of even the easily obtainable food.

The same sort of thing occurs at the end of the rains. There is practically no intermittent period. As a rule, the rains in the Gambia cease very abruptly, with the result that in the open soil the plant simply dries up about a week after the rains stop. This applies more to the prostrate type of groundnuts, such as the typical Gambian or Senegal; upright growing types, such as Natal and Philippine Pink, have a short growing period and ripen off during the middle of the rains.

Phosphatic.

Phosphatic fertilizers are usually applied to (*a*) induce early ripening. (*b*) increase the weight of produce and (*c*) make the plant more resistant to disease.

Experience with upright early ripening varieties of groundnuts which ripened and germinated before the finish of the rains prevented a similar occurrence with the phosphatic plots during 1927 and the nuts were harvested before germination started.

This procedure would be very bad for the groundnut crop of the Gambia if it had to be carried out on a large scale, as, even if the kernel is not damaged by wetting of the shell, the shell itself is darkened in colour and when put on the market its appearance is against it. Moreover, exposure to intermittent rain and sun tends to soften the shell tissues with the result that when being handled in transit, etc., they break down and form dust.

The above is what occurs in an abnormal season such as 1927; during normal years, experience with these and other trials has shown that early ripening is undesirable and that in the Gambia a slightly longer growing season would as a general rule be beneficial to the crop.

In any case, in a normal year the abrupt termination of the rains renders the early ripening effect of phosphates negligible. Table 1 shows that only one of the three phosphatic fertilizers gave as high an average yield as the no manure plot. The other two gave a lower average.

It is probable that phosphatic fertilizers do tend to make groundnuts more resistant to disease, but they appear to have no effect whatever in helping to resist attack by organism responsible for Rosette disease.

Returns for 1926 are as follows :—(See also results of manurial experiments 1926).

Plot.	Manure.	Percentage of plants infected with Rosette disease
3	Basic Slag ... ... Sulphate of Potash	5 per cent.
4	Basic Slag ... ... Sulphate of Ammonia	20 ,,
5	Lime, 1924	75 ,,
6	Nitrate of Soda ... ... Sulphate of Potash	60 ,,
7	Dried Blood	40 ,,
8	Superphosphate	30 ,,
9	Basic Slag	25 ,,
10	Control (no Manure)...	20 ,,

The plots are in two lines of five, Rosette disease affects patches, the most heavily infected plots being at the lower end. It has already been pointed out, under Nitrogenous fertilizers, that what was last year attributed to Rosette in plot 6, Nitrate of Soda-Sulphate of Potash, may very probably have been due to something else.

If Rosette infection in plot 6 is reduced to, say, 40 per cent. then there is no particular resistance to the disease in the plants growing in phospbatic plots.

Nothing much can be said about the effects of Sulphate of Potash as it has always been used in conjunction with another fertilizer. It has already been noted, under rainfall, that, during 1924 and 1927, after the rains commenced, they fell more or less steadily, whereas in 1925, after being normal in June, they fell away during July and in 1926 there were long dry periods.

During the seasons 1924 and 1927 there has been practically no Rosette disease, whilst there was very heavy infection during 1925 and 1926.

During June of 1925 there was sufficient rain to germinate the seeds and to start the plants growing, but during July very little rain fell, with the result that there was nothing to curtail any insect activity, also the plants made very slow growth. The result was that there was a great deal of Rosette.

Season 1926 with rains below the average and long dry periods again produced heavy infection by Rosette.

On the other hand, during 1924 and 1927 with sufficient rain falling steadily during the critical growing period, there was no Rosette.

It is an interesting point that several varieties of millet suffer severely from *Aphis Sorghi*, the natives know it as "Leo" or honey disease and even they notice that there is no "Leo" when there is sufficient rain. As far as it is possible to judge phosphatic fertilizers have no influence whatever on the plant in resisting Rosette.

Combinations of Fertilizers.

There is little to note in connection with yields from the plots with two or more fertilizers in combination. All the plots, irrespective of fertilizers, have suffered equally from Leaf spot "Cercospora personata" which generally attacks the plants just before ripening and seems to have very little influence on the yields.

Economics.

These experiments can go on for a number of years as there are many important points to be cleared up, but it seems fairly certain that there is no place for artificial fertilizers under the native farmers present system of cultivation. The tables show that the maximum yields were obtained in the second year, which was really the third year of being under groundnuts, as the land had been cropped by a native farmer the season before it was taken over by this Department.

But although the manured plots gave a higher yield the second year, so did the control, not quite as high in some cases, but the drop was not so great afterwards.

It seems therefore, that some other factor was responsible for the second year's increase. When the native farmer crops his land for three to five years in succession, realising that the plants will be less robust, he plants more closely and so maintains a good yield, but all the evidence goes to show that after three years the soil should either be fallowed or the crop changed.

In the complication of Tables 6 to 13, no account has been taken of the cost of bringing the manures from Bathurst to the Agricultural Station as the lorry frequently carried a load both ways. The cost of labour for applying the manures was 2/- per acre.

The standard bushel of 28 lbs. has been used, this being the unit used by the merchants when buying. Two shillings and sixpence has been the average price for the 28 lb. bushel for the four years under review.

In every case the yields are to the nearest bushel, the figures are so outstanding that it seems unnecessary to quote more detailed figures.

The average freight for the river is 15/- per ton and if that amount is added to the Agricultural Station costs it would be unwise to advise native farmers to buy artificial fertilizers even if they showed any desire to do so.

TABLE 6

No. 1. Plot.

Bone Meal.

Average cost per acre £3. 3s. 0d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	63	65	19	18
Control (no Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on Control + —	+14	— 2	— 5	— 4
Net profit or loss on Control @ 2s. 6d. per bushel +—	—£1 8 0	—£3 8 0	—£3 15 6	—£3 13 0

Average loss per acre, £3. 1s. 1½d.

TABLE 7.

No. 2. Plot.

Nitrate of Soda, Basic Slag.

Average cost per acre £2. 7s. 6d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	48	57	23	31
Control (no Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on control + —...	— 1	—10	— 1	+ 9
Net profit or loss on control @ 2s. 6d. per bushel+—	—£2 10 0	—£3 12 6	—£2 10 0	—£1 5 0

Average loss per acre, £2. 9s. 4½d.

TABLE 8.

No. 3 Plot.

Nitrate of Soda, Sulphate of Potash, Basic Slag.

Average cost per acre, £1 18s. 8d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	60	54	38	34
Control (no Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on control +—	+11	−13	+14	+12
Net profit or loss on control @ 2s. 6d. per bushel +—	−£0 11 0	−£3 11 2	−£0 3 8	−£0 8 8

Average loss per acre, £1. 3s. 7½d.

TABLE 9.

No. 4 Plot.

Basic Slag, Sulphate of Potash.

Average cost per acre, £2 2s. 6d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	38	67	17	33
Control (no Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on control +—	−11	±	− 7	+11
Net profit or loss on control @ 2s. 6d. per bushel +—	−£3 10 0	−£2 2 6	−£3 0 0	−£0 15 6

Average loss per acre, £2. 7s. 0d.

No. 5 Plot.

Lime, 4 Tons per Acre.

This plot was dressed with chalk before planting the 1924 crop, resulting in a very marked reduction in yield. In addition the plants appeared to be very unhealthy. No further applications of chalk have been made but the plot has each year produced less than the control.

TABLE 10.

No. 6 Plot.

Nitrate of Soda, Sulphate of Potash.

Average cost per acre, £2 18s. 0d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	56	19	8	12
Control (No Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on control +—	+ 7	—48	—16	—10
Net profit or loss on control @ 2s. 6d. per bushel +—	—£2 0 6	—£8 18 0	—£4 18 0	—£4 3 0

Average loss per acre, £4. 19s. 9½d.

TABLE 11.

No. 7 Plot.

Dried Blood.

Average cost per acre, £3 4s. 0d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	51	73	24	29
Control (no Manure)	—	—	—	—
Bushels per acre	49	47	24	22
Difference in yield on control +—	+ 2	+ 26	±	+ 7
Net profit or loss on control @ 2s. 6d. per bushel +—	—£2 19 0	—£2 9 0	—£3 4 0	—£2 6 6

Average loss per acre, £2. 14s. 7½d.

TABLE 12.

No. 8 Plot.

Superphosphate.

Average cost per acre, £1 2s. 0d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	36	59	26	28
Control (no Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on control +—	—13	— 8	+ 2	+ 6
Net profit or loss on control @ 2s. 6d. per bushel +—	—£2 14 0	—£2 2 0	—£0 19 0	—£0 9 0

Average loss per acre, £1. 11s. 0d.

TABLE 13.

No. 9 Plot.

Basic Slag.

Average cost per acre, £1 0s. 0d.

—	1924.	1925.	1926.	1927.
Manured Plot	—	—	—	—
Nuts produced, bushels per acre	48	58	19	22
Control (no Manure)	—	—	—	—
Bushels per acre	49	67	24	22
Difference in yield on control +—	— 1	— 9	— 5	±
Net profit or loss on control @ 2s. 6d. per bushel +—	—£1 2 6	—£2 2 6	—£1 12 6	—£1 0 0

Average loss per acre, £1. 11s. 10½d.

Humus Factor.

It was realised by the end of 1926 that artificial manures alone would not maintain the fertility of the soil. With a view to testing the effect of an application of organic matter to the soil, material was treated with Adco, the intention being to work it into the soil when ploughing.

The material was not sufficiently decayed for this purpose when the planting season came round and the project had to be abandoned. However, owing to the season, the continued absence of humus has been useful and we have seen the effect of the various fertilizers, especially the phosphatic, with everything in their favour and it has been possible to arrive at some more or less definite conclusions. Had the organic matter been added, it would have had some effect on the yields and been yet another factor to be considered.

It is very probable that artificial fertilizers would give a good return if used in a practical scheme of crop rotation. It was very obvious during 1924 and 1925 that the plants would have continued to grow more rapidly during the dry spells if the soil had been in a condition to retain moisture.

These manurial experiments have established the fact that the Gambian soil remains fertile under groundnuts for three years only, even after being fallow for eight years.

Under the present native system of shifting cultivation, eight or even more years fallowing may be possible and of little importance, but under a more intensive system of cultivation long fallow periods are un-economic. Moreover the Gambia crop is limited by population and if exports are to be increased and maintained at a more or less steady figure, provision must be made for the land to carry a greater number of people.

Probably there are parts of the Gambia the soil of which will remain fertile over a longer period than that of the Agricultural Station at Cape St. Mary but the latter may be said to be typical.

At the present stage of the native farmer's development, it is probably impossible, and certainly undesirable, for them to spend money on artificial manures. It is therefore necessary to develop a system of cultivation which will enable the farmer to keep the land fertile on the resources of the country.

At present the cattle supply a certain amount of organic manure but not in sufficient quantities, and it is apparent that some form of green manuring is necessary.

The experiments on the Agricultural Station have shown that growing groundnuts for more than three successive years is not economical, and that in any practical rotation scheme a green manure crop or fallowing is necessary after three years.

Fallowing should be tried, but it also appears to be un-economic in view of what has happened after eight years fallowing in this station. A change of crop might also prove beneficial, but Coos grown on this station after three groundnut crops has not been a great success.

Probably the rotation most likely to give the best results would be one which allows for a green manure crop after three years. If this line of investigation is to be taken up it would be necessary to enlarge the agricultural station, as unless we are prepared to wait a great number of years for results it would be necessary to start investigations along several lines simultaneously.

Special Experiment for the Potash Supply Company.

This experiment was carried out at the request of the Potash Supply Company who were anxious to obtain accurate information on the value of potash in groundnut cultivation under Gambian conditions.

The soil had previously had three annual applications of complete fertilizer. Two acres only could be spared, and owing to a seed shortage two varieties had to be used, half of each acre being planted with a variety.

TABLE 14.

No. 1 Acre.

Two cwts. Dried Blood, 2 cwts. Superphosphate.

2 cwts. Bone Meal.

Plot.	Variety.	Yield per half acre.	Weight of cwt. bushel
		Lbs.	Lbs.
1	Basse	186	26½
2	Philippine White	171	23½

Total yield per acre, 357 lbs.

TABLE 15.

No. 2 Acre.

Two cwts. Dried Blood, 2 cwts. Superphosphate

2 cwts. Bone Meal, 1 cwt. Sulphate of Potash.

Plot.	Variety.	Yield per half acre.	Weight of cwt. bushel.
		Lbs.	Lbs.
1	Basse	280	26½
2	Philippine White	126	22¼

Total yield per acre, 456 lbs.

The tables show that the potash acre gave an increase in yield of 99 lbs. The entire credit for this increase cannot be put to the Potash as the germination of the Basse variety in No. 1 was not as good as in No. 2 plot. However, if the test could be carried out over a number of years it would be possible to arrive at some definite conclusions.

APPENDIX IV.

Tables showing the Analyses of the *Five Best* and the *Five Worst* Cargoes of Groundnuts shipped from The Gambia and Senegal to Marseilles and Bordeaux in 1926–7.

GAMBIA.

Best Cargoes.		Worst Cargoes.	
Yield of Oil. Per cent.	F.F.A.	Yield of Oil. Per cent.	F.F.A.
50·34	0·60	49·20	0·70
50·32	0·70	48·96	0·50
50·13	0·70	48·86	0·55
50·12	0·40	48·71	0 80
50·10	0·70	48·67	0·55
Average 50·20	0·62	48·88	0·62

SENEGAL.

Yield of Oil Per cent.	F.F.A.	Yield of Oil. Per cent.	F.F.A.
50·35	0·93	48·16	0·60
50·35	1·01	48·12	2·50
50·25	0·86	47·96	0·35
50·20	0·77	47·89	0·40
50·19	0·35	47·86	0·85
Average 50·26	0·78	47·99	0·94

The quality of the oil obtained from the Gambia groundnuts showed less variation. Table showing Yield and Quality of Gambia Groundnut Oil obtained from the 1926–7 crop compared with other countries :—

		Yield of Oil. Per cent.	Free Fatty Acid.
1	Gambia	49·60	0·7
2	Senegal	48·99	0·7
3	Cassamance	48·84	1·1
4	Nigeria	47·80	4·3
5	India	46·83	8·4
6	East Africa	45·99	1·4

Numbers 1 to 3 represent undecorticated and 4 to 6 decorticated groundnuts.

APPENDIX V.

Rainfall Recorded at the Official Recording Stations throughout the Colony and Protectorate during the Year 1927.

Province.	Jan. to April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Kombo and Fogni :—										
Bathurst	No rain	0·45	7·56	7·34	22·10	15·32	6·08	1·73	—	60·58
Cape St. Mary ...	,,	0·54	8·10	10·86	28·99	19·05	5·42	4·03	0·04	77·03
Sukuta	,,	0·47	7·88	9·13	33·49	17·48	6·60	3·03	—	78·08
Kansala	,,	0·82	4·82	8·66	16·79	10·17	6·16	0·24	—	47·66
Average for Province	No rain	0·57	7·09	8·99	25·34	15·50	6·06	2·25	0·04	65·84
North Bank :—										
Kerewan	No rain	2·87	4·22	4·57	14·11	11·99	6·46	0·60	No rain	44·82
South Bank :—										
Kudang	No rain	4·22	3·99	4·37	13·20	9·96	4·39	0·36	No rain	40·49
Soma	,,	2·75	7·41	3·94	14·89	14·01	7·57	1·65	,,	52·22
Bansang	,,	3·14	3·89	3·98	14·85	7·70	8·18	1.85	,,	43·59
Average for Province	No rain	3·37	5·09	4·09	14·31	10·55	6·71	1·28	No rain	46·40
McCarthy Island :—										
Kau-ur	No rain	2·05	2·71	5·33	10·03	7·85	3·26	1·75	No rain	32·98
Kuntaur	,,	3·10	4·59	4·54	15·06	7·35	7·65	0·62	,,	42·91
Georgetown ...	,,	2·52	3·91	6·00	13·45	10·05	8·70	0·79	,,	45·42
Lamin Koto ...	,,	2·42	4·09	6·42	15·29	9·06	9·04	0·90	,,	47·22
Average for Province	No rain	2·52	3·82	5·57	13·45	8·57	7·16	1·01	No rain	42·10
Upper River :—										
Mansajang ...	No rain	5·36	3·05	4·68	11·15	13·47	8·74	1·82	No rain	48·27
Wuli	,,	3·41	4·81	4·55	15·89	11·47	9·97	2·01	,,	52·11
Fattoto	,,	2·43	5·01	3·88	12·10	12·70	10·89	2·82	,,	49·83
Average for Province	No rain	3·73	4·29	4·37	13·04	12·54	9·86	2·21	No rain	50·04

APPENDIX VI.

Annual Rainfall, Bathurst, for the years 1888–1927, showing Averages for the last four Decades.

	Inches.		Inches.
1888	39·09	1908	43·54
1889	32·06	1909	56·59
1890	60·31	1910	44·00
1891	53·41	1911	28·14
1892	51·13	1912	33·99
1893	77·89	1913	23·68
1894	55·86	1914	52·33
1895	66·86	1915	47·64
1896	51·18	1916	38·02
1897	33·61	1917	37·68
	—— 49·08 average.		—— 40·50 average.

1898	48·65	1918	54·03
1899	56·17	1919	39·23
1900	43·38	1920	34·29
1901	45·31	1921	35·12
1902	29·42	1922	45·71
1903	57·13	1923	65·38
1904	38·02	1924	56·46
1905	64·16	1925	44·09
1906	64·33	1926	35·05
1907	34·00	1927	60·58
	—— 48·05 average.		—— 46·99 average.

APPENDIX VII.

TABLE SHOWING ANNUAL EXPORTS OF GROUNDNUTS FROM 1900 TO 1927.

Year.	Tons.	Value.
		£
1900	25,605	221,841
1901	25,750	172,405
1902	31,612	193,486
1903	45,477	275,394
1904	43,436	229,287
1905	29,499	169,426
1906	36,050	278,055
1907	40,858	256,685
1908	31,964	245,084
1909	53,644	323,231
1910	58,456	387,942
1911	47,931	437,472
1912	64,169	502,069
1913	67,404	622,079
1914	66,885	650,461
1915	96,151	400,434
1916	46,366	506,098
1917	74,300	869,790
1918	56,490	800,319
1919	71,677	1,172,843
1920	85,190	2,398,444
1921	59,175	628,901
1922	64,800	780,889
1923	64,178	864,885
1924	60,622	861,925
1925	48,700	693,097
1926	61,072	862,578
1927	69,240	967,941

APPENDIX VIII.

Number of Immigrant or "Strange Farmers" Entering the Gambia Annually to Plant Groundnuts.

Year.	Number.
1912	6,525
1913	9,940
1914	14,908
1915	32,220
1916	9,315
1917	20,727
1918	20,509
1919	22,140
1920	24,150
1921	22,048
1922	20,566
1923	17,383
1924	14,188
1925	14,652
1926	13,553
1927	17,237

APPENDIX IX.

Average Local Price Paid for Groundnuts for the last Twenty-eight Years.

Trade 1899–1900 ...	Wharf Towns 1s. 6d.	Shipping Towns 1s. 9d.
„ 1900–1901 ...	„ „ 1s. 6d.	„ „ 1s. 9d.
„ 1901–1902 ...	„ „ 2s.	„ „ 2s. 3d.
„ 1902–1903 ...	„ „ 1s. 4d., 1s. 2d.	„ „ 1s. 7d., 1s. 2d
„ 1903–1904 ...	„ „ 1s.	„ „ 1s. 3d.
„ 1904–1905 ...	„ „ 1s. 1d.	„ „ 1s. 4d.
„ 1905–1906 ...	„ „ 1s. 3d.	„ „ 1s. 6d.
„ 1906–1907 ...	„ „ 1s. 3d.	„ „ 1s. 6d.
„ 1907–1908 ...	„ „ 1s. 9d.	„ „ 2s.
„ 1908–1909 ...	„ „ 1s. 1d., 1s. 2d.	„ „ 1s. 4d., 1s. 2d.
„ 1909–1910 ...	„ „ 1s. 4d.	„ „ 1s. 7d.
„ 1910–1911 ...	„ „ 2s.	„ „ 2s. 3d.
„ 1911–1912 ...	„ „ 1s. 6d.	„ „ 1s. 9d.
„ 1912–1913 ...	„ „ 2s.	„ „ 2s. 3d.
„ 1913–1914 ...	„ „ 2s. 1d.	„ „ 2s. 4d.
„ 1914–1915 ...	„ „ 4d., 1s. 2d.	„ „ 7d., 1s. 2d.
„ 1915–1916 ...	„ „ 1s. 10d., 1s. 2d. ...	„ „ 2s. 1d., 1s. 2d.
„ 1916–1917 ...	„ „ 2s. 4d., 1s. 2d.	„ „ 2s. 7d., 1s. 2d.
„ 1917–1918 ...	„ „ 2s. 6d.	„ „ 2s. 9d.
„ 1918–1919 ...	„ „ 2s. 7d., 1s. 2d.	„ „ 2s. 10d., 1s. 2d.
„ 1919–1920 ...	„ „ 5s. 3d.	„ „ 5s. 6d.
„ 1920–1921 ...	„ „ 2s. 9d.	„ „ 3s.
„ 1921–1922 ...	„ „ 2s. 3d.	„ „ 2s. 6d.
„ 1922–1923 ...	„ „ 2s. 4d., 1s. 4d.	„ „ 2s. 7d., 1s. 2d.
„ 1923–1924 ...	„ „ 2s. 5d.	„ „ 2s. 8d.
„ 1924–1925 ...	„ „ 2s. 4½d.	„ „ 2s. 9d.
„ 1925–1926 ...	„ „ 2s. 2¼d.	„ „ 2s. 3¾d.
„ 1926–1927 ...	„ „ 2s. 6d.	„ „ 2s. 7d.
„ 1927–1928 ...	„ „ 2s. 9d.	„ „ 2s. 10½d.

Note.—The above prices are only an average for each trading season. For instance, in 1919-1920 as much as 8s. per bushel of 28 lbs. was paid, this being the highest price ever paid in the Gambia.

APPENDIX X.

Work Conducted at The Imperial Institute during the Year 1927 for The Gambia.

GROUNDNUTS FROM THE GAMBIA.

The eight samples of groundnuts which are the subject of this report were received at the Imperial Institute on the 11th February, 1928, and are referred to in letter No. Ag.B. 71/1928 of the 17th January, 1928, from the Director of Agriculture.

It was stated that the rainfall at the station where the nuts were grown had been abnormally high, and it was desired to ascertain whether this circumstance had caused an increase in the amount of free fatty acid in the oils yielded by the kernels.

Description.

The samples all consisted of undecorticated groundnuts, and were as follows :—

Variety.	Weight in lb.	Description of Nuts.	Description of Kernels.
Mauritius ...	6¼	The nuts mostly contained 2 kernels, and measured from ⅞ to 1½ inches (mostly 1 to 1¼ inch) in length and ½ inch in diameter.	Plump, medium to large, with pinkish-brown skins.
Basse ...	6¼	The nuts mostly contained 2 kernels, but 14 per cent. contained only one. They measured from ¾ to 1¼ inches (mostly ¾ to 1 inch) in length and ½ inch in diameter.	Plump, medium-sized, with pinkish-brown skins.
Gambia ...	7	The nuts mostly contained 2 kernels, and measured ¾ to 1¼ inches (mostly 1 inch) in length and ½ inch in diameter.	Plump, small to medium with pinkish-brown skins.
Philippine White	7¼	The nuts mostly contained 3 kernels, but 23 per cent. contained only two. They measured 1¼ to 1¾ inches (mostly 1½ inches) in length and ½ inch in diameter.	Plump, medium to large, with cream-coloured skins; a few discoloured.
Philippine Pink	7¼	The nuts mostly contained 2 kernels, but 11 per cent. contained only one. They measured ¾ to 1¼ inches (mostly ⅞ inch) in length and ½ inch in diameter.	Plump, small to medium, with salmon-pink skins.
Senegal ...	6¾	The nuts mostly contained 2 kernels, and measured from ½ to ¾ inch (mostly ¾ inch) in length and ⅜ inch in diameter.	Plump, small, with pinkish-brown skins.
Baol... ...	8	The nuts mostly contained 2 kernels, and measured from ¾ to 1½ inches (mostly ¾ to 1 inch) in length and ½ inch in diameter.	Plump, small to medium, with pinkish-brown skins.
Zaria ...	7¼	The nuts mostly contained 2 kernels, and measured 1 inch in length and ½ inch in diameter.	Plump, large, with pinkish-brown skins.

The proportions of husk and kernel were as follows :—

Variety.	Husk.	Kernel.
	Per cent.	Per cent.
Mauritius	22	78
Basse	22	78
Gambia	24	76
Philippine White...	23	77
Philippine Pink	23	77
Senegal	21	79
Baol	20	80
Zaria	22	78

Results of Examination.

Kernels.—The kernels were examined with the following results :—

Variety.	Average weight of kernels.	Moisture in kernels.	Yield of Oil.		
			Expressed on kernels as received.	Expressed on moisture free kernels.	Expressed on entire nuts.
	Grams.	Per cent.	Per cent.	Per cent.	Per cent.
Mauritius	0·52	5·1	50·9	53·6	39·7
Basse...	0·49	4·9	50·0	52·6	39·0
Gambia	0·43	5·0	49·9	52·5	37·9
Philippine White	0·57	4·7	50·9	53·4	39·2
Philippine Pink	0·46	5·4	46·0	48·6	35·4
Senegal	0·34	4·9	49·6	52·2	39·2
Baol	0·39	4·8	50·4	52·9	40·3
Zaria	0·55	4·8	49·4	52·4	38·9

Oil.—The oils, extracted with light petroleum, were chemically examined with the following results :—

Variety.	Acid value.	Free fatty acids (expressed as oleic acid).
		Per cent.
Mauritius	2·4	1·21
Basse	2·2	1·11
Gambia	4·3	2·16
Philippine White...	5·5	2·77
Philippine Pink	0·6	0·30
Senegal	2·2	1·11
Baol	1·1	0·55
Zaria	6·0	3·02

These results show that the nuts in every case contained normal percentage of oil, although in the " Philippine Pink " variety the oil content was appreciably lower than in the other samples.

The acidity of the oils, as extracted with light petroleum, was satisfactorily low in the " Mauritius," " Basse," " Philippine Pink," " Senegal " and " Baol " varieties. In the other three cases the amount of free fatty acids present in the oil exceeded 2 per cent. which is usually regarded as the limit for undecorticated groundnuts of " good merchantable quality."

Remarks.

Of the eight varieties of groundnuts now dealt with, seven were represented in the series of samples which were the subject of Imperial Institute Report dated March 25th, 1927 ; the other variety, viz. " Baol," has not previously been examined at the Imperial Institute. A comparison with the results obtained in 1927, shows that in the present samples the kernels formed a higher proportion of the total weight of the nuts, and that in most cases the kernels were larger and yielded more oil, but that the oils contained a slightly higher percentage of free fatty acids.